COMPLETING
105
TVA 3.T25:51 1983

TENNESSEE VALLEY AUTHORITY

ORIGINAL

RADIOLOGICAL HEALTH STAFF

BEST COPY AVAILABLE

ENVIRONMENTAL RADIOACTIVITY LEVELS
WATTS BAR NUCLEAR PLANT
Annual Report 1983
TVA/POWER/RHS

April 1984

BEST COPY AVAILABLE

CONTENTS

	Page
List of Tables	iii
List of Figures	iv
Introduction	1
Atmospheric Monitoring	11
Terrestrial Monitoring	23
Reservoir Monitoring	45
Quality Control	61
Conclusions	61

BEST COPY AVAILABLE

LIST OF TABLES

	Page
Table 1 - Environmental Radioactivity Sampling Schedule	3
Table 2 - Environmental Monitoring Station Locations - Watts Bar Nuclear Plant	4
Table 3 - Detection Capabilities for Environmental Sample Analysis	5
Table 4 - Results Obtained in Interlaboratory Comparison Program	7
Table 5 - Maximum Permissible Concentrations for Nonoccupational Exposure	13
Table 6 - Radioactivity in Air Filter	14
Table 7 - Radioactivity in Rainwater	15
Table 8 - Radioactivity in Heavy Particle Fallout	16
Table 9 - Radioactivity in Charcoal Filters	17
Table 10 - Radioactivity in Atmospheric Moisture	18
Table 11 - Radioactivity in Milk	26
Table 12 - Radioactivity in Vegetation	27
Table 13 - Radioactivity in Soil	28
Table 14 - Radioactivity in Well Water	29
Table 15 - Radioactivity in Public Water Supply	30
Table 16 - Environmental Gamma Radiation Levels	31
Table 17 - Radioactivity in Apples	32
Table 18 - Radioactivity in Cabbage	33
Table 19 - Radioactivity in Corn	34
Table 20 - Radioactivity in Green Beans	35
Table 21 - Radioactivity in Potatoes	36
Table 22 - Radioactivity in Tomatoes	37
Table 23 - Radioactivity in Beef	38
Table 24 - Radioactivity in Poultry	39
Table 25 - Sampling Schedule - Reservoir Monitoring	47
Table 26 - Radioactivity in Surface Water	48
Table 27 - Radioactivity in Channel Catfish (Flesh)	49
Table 28 - Radioactivity in White Crappie (Flesh)	50
Table 29 - Radioactivity in Smallmouth Buffalo (Flesh)	51
Table 30 - Radioactivity in Smallmouth Buffalo (Whole)	52
Table 31 - Radioactivity in Plankton	53
Table 32 - Radioactivity in Sediment	54
Table 33 - Radioactivity in Shoreline Sediment	55
Table 34 - Radioactivity in Clam Flesh	56
Table 35 - Radioactivity in Clam Shell	57

BEST COPY AVAILABLE

LIST OF FIGURES

	Page
Figure 1 - Tennessee Valley Region	10
Figure 2 - Atmospheric and Terrestrial Monitoring Network	19
Figure 3 - Watts Bar Nuclear Plant Site Monitoring Stations	20
Figure 4 - Annual Average Gross Beta Activity in Air (Particulate Filters) - WBN	21
Figure 5 - Annual Average Gross Beta Activity in Drinking Water - WBN	40
Figure 6 - Annual Average Gross Beta Activity in Surface Water - WBN	41
Figure 7 - TLD Locations WBN	42
Figure 8 - Direct Radiation Levels - WBN	43
Figure 9 - Direct Radiation Levels - WBN, 4-Quarter Moving Average	43
Figure 10 - Reservoir Monitoring Network	58
Figure 11 - Annual Average Cesium-137 in Sediment - WBN	59
Figure 12 - Annual Average Cobalt-60 in Sediment - WBN	60

BEST COPY AVAILABLE

ENVIRONMENTAL RADIOACTIVITY LEVELS

WATTS BAR NUCLEAR PLANT

1983

Introduction

The Watts Bar Nuclear Plant (WBN), being constructed by the Tennessee Valley Authority, is located on a site owned by TVA containing 1770 acres of land in Rhea County, Tennessee, bounded on the east by Chickamauga Reservoir (see figure 1). The site is approximately 50 miles (80 kilometers) northeast of Chattanooga, Tennessee, and 8 miles (13 kilometers) southeast of Spring City, Tennessee. The plant will consist of two pressurized water reactors; each unit is rated at 3,411 MWt and 1,160 MWe. Fuel load in unit 1 is scheduled for 1984.

A preoperational environmental radiological monitoring program was implemented in December 1976. This program has the objective of establishing a baseline of data on the distribution of natural and manmade radioactivity in the environment near the plant site. This report presents the results obtained from that program during 1983.

The Radiological Health Staff (Office of Power) and the Office of Natural Resources and Economic Development carried out the sampling program outlined in tables 1 and 25. Sampling locations are shown in figures 2, 3, 7, and 10, and table 2 describes the locations of the atmospheric and terrestrial monitoring stations. All the radiochemical and instrumental analyses were conducted in TVA's Western Area Radiological Laboratory (WARL) located at Muscle Shoals, Alabama, and Eastern Area Radiological Laboratory (EARL) at Vonore, Tennessee, with EARL, until its closing in October 1983, being the primary laboratory for samples from WBN. Alpha and beta analyses were performed on Beckman Low Beta II, Beckman Wide Beta II, and Tennelec LB5100 low-background proportional counters. Nuclear Data (ND) Model 100 multichannel analyzer systems employing sodium iodide, NaI(Tℓ), detectors and ND Model 6620 system in conjunction with germanium, detection systems were used to analyze the samples for specific gamma-emitting radionuclides. At EARL, an ND Model 6620 system was used with both types of detectors. Samples of water, vegetation, air particulates, food crops, and charcoal (specific analysis for ^{131}I) are routinely counted with NaI(Tℓ) detection systems. If significant concentrations of radioisotopes are identified, or if there is a reasonable expectation of increased radioactivity levels (such as during periods of increased fallout), these samples are counted on the germanium systems. Identification of gamma-emitting radionuclides in all other types of samples is routinely performed by analysis on the germanium system. TVA-fabricated and Tennelec beta-gamma coincidence counting systems are utilized for the determination of ^{131}I concentrations in milk. Tritium determinations are made with Beckman LS150, Beckman LS100C, and Packard Model 3250 liquid scintillation counting systems.

BEST COPY AVAILABLE

Data were entered in computer storage for processing specific to the analysis conducted. A computer, employing the ALPHA-M least-squares code, a multimatrix technique, was used to estimate the activities of the gamma-emitting nuclides analyzed by NaI(Tℓ). The data obtained by germanium detectors were resolved by the appropriate analyzer software and the software program routine HYPERMET.

The detection capabilities for environmental sample analysis given as the nominal lower limits of detection (LLD) are listed in table 3. Samples processed by NaI(Tℓ) gamma spectroscopy were analyzed for 14 specific gamma-emitting radionuclides and radionuclide combinations[a]. For these analyses, radionuclide combinations such as ^{103,106}Ru and ^{95}Zr-Nb are analyzed as one radionuclide. All photopeaks found in germanium spectra were identified and quantified. Many of the isotopes identified by germanium spectral analysis are naturally occurring or naturally produced radioisotopes, such as ^{7}Be, ^{40}K, ^{212}Bi, ^{214}Bi, ^{212}Pb, ^{214}Pb, ^{226}Ra, etc. LLDs for the analysis of the radionuclides listed below[a] are given in table 3B. LLDs for additional radionuclides identified by germanium analysis were calculated for each analysis and nominal values are listed in the appropriate data tables. In the instance where an LLD has not been established, an LLD value of zero is assumed. An isotope may be identified and a valid result obtained and yet a mean and a range of 0 can be shown if the activity is between 0 and 0.01 since the output program displays results to two decimal places. A notation in a table of "__ values <LLD" for an isotope with no established LLD does not imply a value less than 0; rather, it indicates that the isotope was not identified in that specific group of samples. For each sample type, only the radionuclides for which values greater than the LLD were reported are listed in the data tables.

TVA's WARL (as did EARL until its closing) participates in the Environmental Radioactivity Laboratory Intercomparison Studies Program conducted by EPA-Las Vegas. This program provides periodic cross-checks on samples of the type and radionuclide composition normally analyzed in an environmental radiological monitoring program. Routine sample handling and analysis procedures were employed in the evaluation of these samples. The results received during calendar year 1983 are shown in table 4. The ±3σ limits based on one measurement were divided by the square root of 3 to correct for triplicate determinations.

---

[a]The following radionuclides and radionuclide combinations are quantified by the ALPHA-M least-squares computer code: ^{141,144}Ce; ^{51}Cr; ^{131}I; ^{103,106}Ru; ^{134}Cs; ^{137}Cs; ^{95}Zr-Nb; ^{58}Co; ^{54}Mn; ^{65}Zn; ^{59}Fe; ^{60}Co; ^{40}K; and ^{140}Ba-La.

BEST COPY AVAILABLE

Table 1
ENVIRONMENTAL RADIOACTIVITY SAMPLING SCHEDULE

Station Location	Air Filter	Charcoal Filter	Rain-water	Heavy Particle Fallout	Atmospheric Moisture	Soil	Vegetation	Milk	Well Water	Public Water	Aquatic Life and Sediment
Site SSW	W	W	M	M	BW	S					
Site N	W	W	M	M	BW	S					
Smith Bend	W	W	M	M		S	Q		M		
Spring City	W	W	M	M		S				M	
Cedine	W	W	M	M		S					
Ten Mile	W	W	M	M		S					
Decatur	W	W	M	M		S					
Goodfield	W	W	M	M		S					
Rockwood	W	W	M	M		S					
Dayton	W	W	M	M	BW	S				M	
Farm H							Q	M	M[a]		
Farm L							Q	M	M[a]		
Farm Mo							Q	M	M[a]		
Control Farms							Q	M[b]	M[b]		
Onsite Wells (7)[c]									M		
Watts Bar Reservation										M	
C. F. Industries										M	
Nickajack/Chickamauga/Watts Bar Reservoirs											Q[d]

W - Weekly BW - Biweekly M - Monthly (every 4 weeks) Q - Quarterly S - Semiannually a. Considered as controls for well water. b. Control farms are also part of SQN program and some locations are sampled weekly. c. One onsite well was discontinued in June 1983. d. Some control samples are part of the SQN program and are collected semiannually.

Table 2

ENVIRONMENTAL MONITORING STATION LOCATIONS

WATTS BAR NUCLEAR PLANT

Sample Station	Approximate Distance and Direction from Plant		
Indicator Stations			
LM-1 WB	0.5 mile	(0.8 kilometers)	SSW
LM-2 WB	0.5 mile	(0.8 kilometers)	N
PM-1 WB, Smith Bend	3.75 miles	(6.0 kilometers)	SW
PM-2 WB, Spring City, TN	7 miles	(11.3 kilometers)	NW
PM-3 WB, Cedine Camp	11.5 miles	(18.5 kilometers)	NNE
PM-4 WB, Ten Mile, TN	7.75 miles	(12.5 kilometers)	NE
PM-5 WB, Decatur, TN	6.25 miles	(10.1 kilometers)	S
PM-6 WB, Goodfield, TN	9 miles	(14.5 kilometers)	SSW
Farm H[a]	4.75 miles	(7.6 kilometers)	W
Farm L[a]	1.5 miles	(2.4 kilometers)	SSW
Farm Mo[a]	4.5 miles	(7.2 kilometers)	NW
Control Stations			
RM-1 WB, Rockwood, TN	17.25 miles	(27.8 kilometers)	NNE
RM-2 WB, Dayton, TN (Identical with RM-2 SQ, Sequoyah Nuclear Plant)	15 miles	(24.1 kilometers)	SW
Farm S	19.5 miles	(31.4 kilometers)	SW
Farm B	15 miles	(24.1 kilometers)	E
Farm C	16 miles	(25.7 kilometers)	SSW

a. Considered as controls for well water.

BEST COPY AVAILABLE

Table 3

DETECTION CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS

A. Specific Analyses

NOMINAL LOWER LIMIT OF DETECTION (LLD)*

	Air Particulates pCi/m^3	Charcoal pCi/m^3	Fallout mCi/Km^2	Water pCi/l	Vegetation and grain pCi/g, dry	Soil and Sediment pCi/g, dry	Fish, clam flesh, plankton, Ci/g, dry	Clam shells pCi/g, dry	Foods, meat, poultry, pCi/Kgm, wet	Milk pCi/l
Total α				0.4	0.01				1.5	
Gross α	0.005			2.0	0.05	0.35	0.1	0.7		
Gross β	0.01		0.05	2.4	0.20	0.70	0.1	0.7	25	
^{3}H				330						0.5
^{131}I		0.02								
^{89}Sr	0.005			10	0.25	1.5	0.5	5.0	40	10
^{90}Sr	0.001			2	0.05	0.3	0.1	1.0	8	2

*All LLD values for isotopic separations are calculated by the method developed by Pasternack and Harley as described in HASL-300. Factors such as sample size, decay time, chemical yield, and counting efficiency may vary for a given sample; these variations may change the LLD value for the given sample. The assumption is made that all samples are analyzed within one week of the collection date. Conversion factors: 1 pCi = 3.7×10^{-2} Bq; 1 mCi = 3.7×10^{7} Bq.

Table 3

DETECTION CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS

B. Gamma Analyses

NOMINAL LOWER LIMIT OF DETECTION (LLD)

	Air particulates pCi/m³		Water and milk pCi/l		Vegetation and grain pCi/g, dry		Soil and sediment pCi/g, dry		Fish pCi/g, dry		Clam flesh and plankton pCi/g, dry		Clam shells pCi/g, dry		Foods,(tomatoes potatoes, etc.) pCi/Kg, wet		Meat and poultry pCi/Kg, wet	
	NaI*	Ge(Li)**	NaI	Ge(Li)	NaI	Ge(Li)	NaI	Ge(Li)	NaI	Ge(Li)	NaI	Ge(Li)	NaI	Ge(Li)	NaI	Ge(Li)	NaI	Ge(Li)
^{144}Ce	0.03		38		0.55		0.35		0.35				0.35		34		90	
^{144}Ce		0.02		33		0.22		0.06		0.06		0.35		0.06		33		40
^{51}Cr	0.07	0.03	60	44	1.10	0.47	0.60	0.10	0.60	0.10		0.56	0.60	0.10	60	44	200	90
^{131}I	0.01	0.01	15	8	0.35	0.09	0.20	0.02	0.20	0.02		0.07	0.20	0.02	15	8	50	20
^{106}Ru	0.04		40		0.65		0.45		0.45				0.45		40		150	
^{106}Ru		0.03		40		0.51		0.11		0.11		0.74		0.11		40		90
^{134}Cs	0.01	0.02	10	26	0.20	0.33	0.12	0.08	0.12	0.08		0.48	0.12	0.08	10	26	40	50
^{137}Cs	0.01	0.01	10	5	0.20	0.06	0.12	0.02	0.12	0.02		0.08	0.12	0.02	10	5	40	15
^{95}Zr-Nb	0.01		10		0.20		0.12		0.12				0.12		10		40	
^{95}Zr		0.01		10		0.11		0.03		0.03		0.15		0.03		10		20
^{95}Nb		0.01		5		0.05		0.01		0.01		0.07		0.01		5		15
^{58}Co	0.02	0.01	15	5	0.23	0.05	0.20	0.01	0.20	0.01		0.07	0.20	0.01	15	5	55	15
^{54}Mn	0.02	0.01	10	5	0.20	0.05	0.15	0.01	0.15	0.01		0.08	0.15	0.01	10	5	40	15
^{65}Zn	0.02	0.01	15	9	0.35	0.11	0.23	0.02	0.23	0.02		0.17	0.23	0.02	15	8	70	20
^{60}Co	0.01	0.01	10	5	0.17	0.06	0.11	0.01	0.11	0.01		0.08	0.11	0.01	10	5	30	15
^{40}K	0.10		150		2.50		0.90		0.90				0.90		150		400	
^{140}Ba-La	0.02		15		0.68		0.15		0.15				0.15		15		50	
^{140}Ba		0.02		25		0.34		0.07		0.07		0.30		0.07		25		50
^{140}La		0.01		7		0.08		0.02		0.02		0.10		0.02		7		15

*The NaI(Tl) LLD values are calculated by the method developed by Pasternack and Harley as described in HASL-300 and Nucl. Instr. Methods 91, 533-40 (1971). These LLD values are expected to vary depending on the activities of the components in the samples. These figures do not represent the LLD values achievable on a given sample. Water is counted in a 3.5-l Marinelli beaker. Vegetation, fish, soil, and sediment are counted in a 1-pint container as dry weight. The average dry weight is 120 grams for vegetation and 400-500 grams for soil sediment and fish. Meat and poultry are counted in a 1-pint container as dry weight, then corrected to wet weight using an average moisture content of 70%. Average dry weight is 250 grams. Air particulates are counted in a well crystal. The counting system consists of a multichannel analyzer and either a 4" x 4" solid or 4" x 5" well NaI(Tl) crystal. The counting time is 4000 seconds. All calculations are performed by the least-squares computer program ALPHA-M. The assumption is made that all samples are analyzed within one week of the collection date.

**The Ge(Li) LLD values are calculated by the method developed by Pasternack and Harley as described in HASL-300. These LLD values are expected to vary depending on the activities of the components in the samples. These figures do not represent the LLD values achievable on given samples. Water is counted in either a 0.5-L or 3.5-L Marinelli beaker. Solid samples such as soil, sediment, and clam shells are counted in a 0.5-L Marinelli beaker as dry weight. The average dry weight is 400-500 grams. Air filters and very small volume samples are counted in petri dishes centered on the detector endcap. The counting system consists of a ND-6620 multichannel analyzer and germanium detector having an efficiency of at least 20 percent. The counting time is normally 4-8 hours. All spectral analysis is performed using the software program HYPERMET. The assumption is made that all samples are analyzed within one week of the collection date.
Conversion factor: 1 pCi = 3.7 x 10^{-2} Bq.

Table 4

Results Obtained in Interlaboratory Comparison Program

A. Air Filter (pCi/filter)

Date	Gross Alpha			Gross Beta			Strontium-90			Cesium-137		
	EPA value (±3σ)	TVA AVG.[a] WARL	[b] EARL	EPA value (±3σ)	TVA AVG. WARL	EARL	EPA value (±3σ)	TVA AVG. WARL	EARL	EPA value (±3σ)	TVA AVG. WARL	EARL
3/83	26±11	25	25	68±9	69	63	20±3	21	17	29±9	30	25
8/83	13±9	14		36±9	38		10±3	11		15±9	17	

B. Tritium in Urine (pCi/L)

Date	EPA Value (±3σ)	TVA AVERAGE	
		WARL	EARL
3/83	2470±610	2420	2540
5/83	1330±575	1793	1650[c]
6/83	1589±585	1753	1580
11/83	1008±585	1053	

[a] Western Area Radiological Laboratory, Muscle Shoals, Alabama

[b] Eastern Area Radiological Laboratory, Vonore, Tennessee, closed 10/83

[c] Equipment failure, values determined after report date

Table 4 (continued)

Results Obtained in Interlaboratory Comparison Program

C. Radiochemical Analysis of Water (pCi/L)

Date	Gross Alpha			Gross Beta			Strontium - 89			Strontium - 90			Tritium			Iodine -131		
	EPA value (±3σ)	TVA WARL	AVG. EARL	EPA value (±3σ)	TVA WARL	AVG. EARL	EPA value (±3σ)	TVA WARL	AVG. EARL	EPA value (±3σ)	TVA WARL	AVG. EARL	EPA value (±3σ)	TVA WARL	AVG. EARL	EPA value (±3σ)	TVA WARL	AVG. EARL
1/83	29±13	27	25	31±9	29	28	29.2±8.7	33.0	16±10.6[ef]	17.2±2.6	17.7	15.9±3.2[e]						
2/83													2560±611	2510	2627			
3/83	21 14	27	35	28±9	28	32												
4/83													3330±627	3733	3373	26.8±10.4	28.0	25.3
5/83	11±9	10	11	57±9	53	43	57.1±8.7	63.7	71.3[f]	37.7±3.3	38.3	29.3[f]						
5/83[d]	64±28	47	60	149±13	133[g]	136	24±9	29	31	13±3	13	10						
6/83													1529±584	1573	1577			
7/83	7±9	7	6	22±9	22	20												
8/83													1836±592	1930	1807	14±10	14	14
9/83	5±9	5		9±9	10		15±9	13		10±3	12							
10/83													1210±570	720				
11/83	14±9	13		16±9	18													
11/83[d]	22±9	19		63±9	61		17±9	14		8±3	6							
12/83													2389±608	2390		20±10	18	

D. Gamma-Spectral Analysis of Water (pCi/L)

Date	Chromium - 51			Cobalt - 60			Zinc - 65			Ruthenium - 106			Cesium - 134			Cesium - 137		
	EPA value (±3σ)	TVA WARL	AVG. EARL	EPA value (±3σ)	TVA WARL	AVG. EARL	EPA value (±3σ)	TVA WARL	AVG. EARL	EPA value (±3σ)	TVA WARL	AVG. EARL	EPA value (±3σ)	TVA WARL	AVG. EARL	EPA value (±3σ)	TVA WARL	AVG. EARL
2/83	45±9	45	<35[f]	22±9	24	24	21±9	22	25	48±9	55	50	20±9	20	20	19±9	18	18
5/83[d]				30±9	33	33							33±9	32	33	27±9	27	28
6/83	60±9	67	<72	13±9	14	16	36±9	38	36	40±9	42	<36	47±9	46	47	26±9	27	27
10/83	31±9	47		19±9	20		40±9	41		52±9	53		15±9	17		22±9	25	
11/83[d]				11±9	11								15±9	15		15±9	15	

[d] Laboratory Performance Evaluation Study

[e] Only 2 values reported, calculated error terms increase

[f] Previous and subsequent results satisfactory. No known explanation.

[g] Calibration of beta detectors is done with Cs-137. Nine isotopes and their daughters were present in this sample. Average value reported nationwide was 136 pCi/L.

Table 4 (continued)

Results Obtained in Interlaboratory Comparison Program

E. Foods (pCi/kg, Wet Weight)

Date	Strontium - 89			Strontium - 90			Iodine - 131			Cesium - 137			Barium - 140			Potassium - 40		
	EPA value (±3σ)	TVA WARL	AVG. EARL	EPA value (±3σ)	TVA WARL	AVG. EARL	EPA value (±3σ)	TVA WARL	AVG. EARL	EPA value (±3σ)	TVA WARL	AVG. EARL	EPA value (±3σ)	TVA WARL	AVG. EARL	EPA value (±3σ)	TVA WARL	AVG. EARL
3/83	34.6±8.7	40.0	31.7	27.8±2.6	28.3	31.3[h]	36.9±10.4	33.3	37.7	31.3±8.7	29.7	30.0	0	<25	<15	2592±225	2533	2887[h]

F. Milk (pCi/L)

Date	Strontium - 89			Strontium - 90			Iodine - 131			Cesium - 137			Barium - 140			Potassium - 40		
	EPA value (±3σ)	TVA WARL	AVG. EARL	EPA value (±3σ)	TVA WARL	AVG. EARL	EPA value (±3σ)	TVA WARL	AVG. EARL	EPA value (±3σ)	TVA WARL	AVG. EARL	EPA value (±3σ)	TVA WARL	AVG. EARL	EPA value (±3σ)	TVA WARL	AVG. EARL
2/83	37.4±8.7	i	42.3	17.8±2.6	i	18	54.5±10.4	52.7	56.0	25.6±8.7	22.3	26.7	0	<25	<20	1512±132	1497	1613
6/83	25±9	27	29	16±3	17	18	30±10	30	38	47±9	48	47				1486±128	1520	1480
10/83	15±9	16		14±3	13		40±10	39		33±9	34					1550±135	1563	

[h] A history of sporadic difficulty with this sample type for all participants nationwide is probably due to sample inhomogeneity.

[i] Sample spoiled before analysis

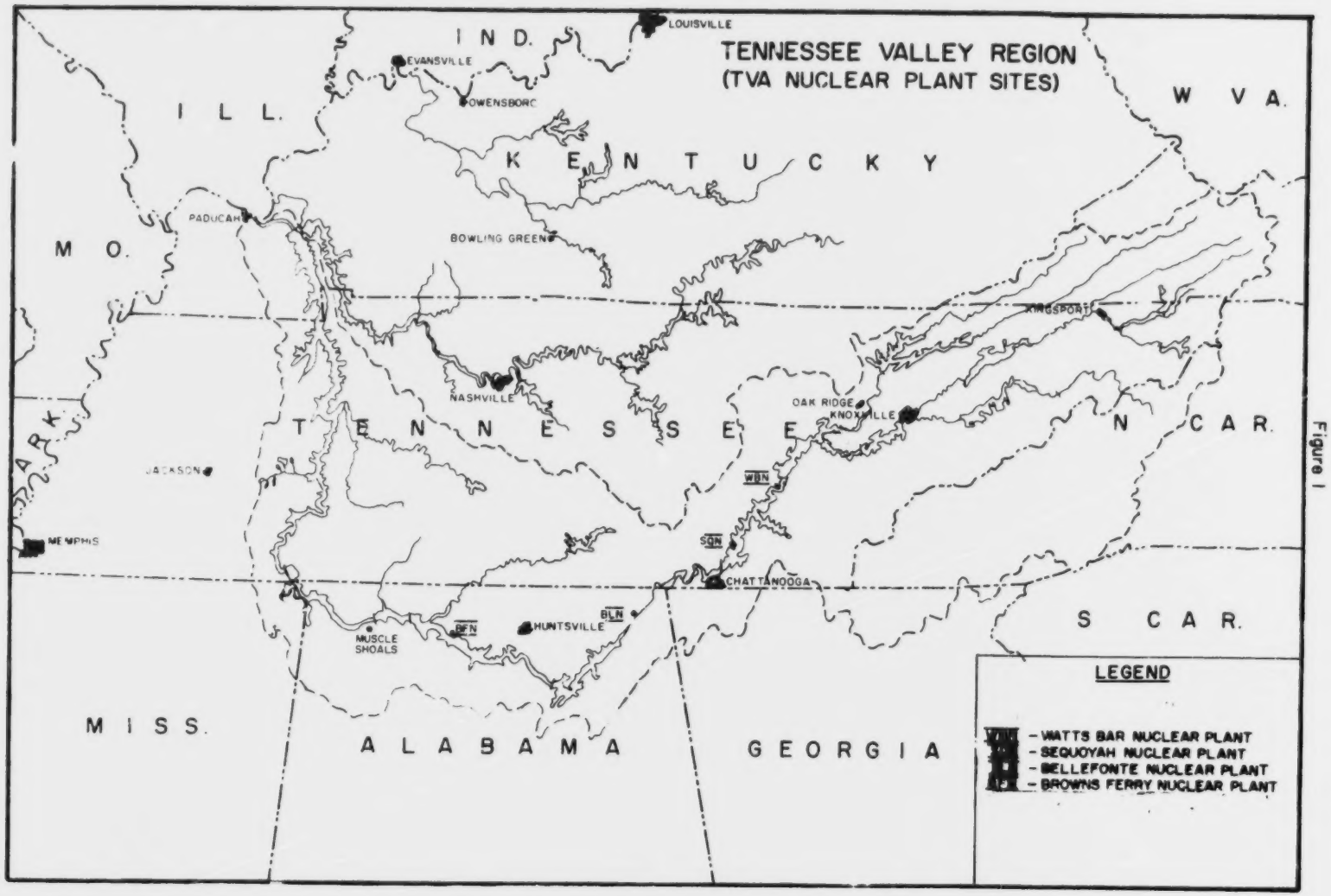

TENNESSEE VALLEY REGION
(TVA NUCLEAR PLANT SITES)
LOUISVILLE
IND.
EVANSVILLE
OWENSBORO
ILL.
W VA.
KENTUCKY
PADUCAH
MO.
BOWLING GREEN
KINGSPORT
NASHVILLE
OAK RIDGE
KNOXVILLE
ARK.
TENNESSEE
N CAR.
JACKSON
WBN
MEMPHIS
SQN
CHATTANOOGA
S CAR.
BLN
MUSCLE SHOALS
BFN
HUNTSVILLE
MISS.
ALABAMA
GEORGIA
LEGEND
- WATTS BAR NUCLEAR PLANT
- SEQUOYAH NUCLEAR PLANT
- BELLEFONTE NUCLEAR PLANT
- BROWNS FERRY NUCLEAR PLANT

Figure 1

Atmospheric Monitoring

The atmospheric monitoring network is divided into three subgroups. Two local air monitors are located within the plant boundary. Six perimeter air monitors are located at distances out to 11 miles (18 kilometers) from the plant in the towns of Spring City and Decatur, and in four other populated areas. The remote air monitors are located at distances out to 17 miles (27 kilometers) from the plant in the towns of Dayton and Rockwood. See table 2 and figures 2, 3, and 7.

At each monitor, air is continuously pulled through a Hollingsworth and Vose LB 5211 glass fiber filter at a flow rate of 3 ft^3/min (0.085 m^3/min). In series with, but downstream of, the particulate filter, is a charcoal filter used to collect iodine. Each monitor has a collection tray and storage container to collect rainwater on a continuous basis, and a horizontal platform covered with gummed acetate to catch and hold heavy particle fallout. Moisture is collected from the atmosphere at each local monitor and at one remote monitor and analyzed for tritium.

Each of the local and perimeter air monitors is fitted with a GM tube that continuously scans the particulate filter. The disintegration rate of the atmospheric radioactivity is continuously recorded at each station. The data from the two local monitors and from perimeter monitors (PM) 1, 2, 4, and 5 are radiotelemetered into the plant control room.

Air filters are collected weekly and analyzed for gross beta activity. The samples are composited monthly for analysis for specific gamma-emitting radionuclides and quarterly for ^{89}Sr and ^{90}Sr content. No analyses are performed until three days after collection. Analytical results are presented in table 6. During this report period equipment testing was conducted at two local monitoring stations (LM-1 WB and LM-2 WB) resulting in seven weekly samples for gross beta activity and two monthly composites for gamma-emitting radionuclides not being collected. Eight additional weekly air filters were not collected and two monthly composites were not available because of equipment malfunction. Hazardous conditions and inaccessibility prevented collection of four weekly air filters and on two occasions air filters were inadvertently damaged or destroyed during processing and were unusable for analysis. One quarterly strontium was not done because the filters were unusable.

The annual averages of the gross beta activity in the air particulate filters at the indicator stations (local and perimeter monitors) and at the control stations (remote monitors) for the years 1977 through 1983 are presented in figure 4. Increased levels due to fallout from atmospheric nuclear weapons testing are evident, especially in 1977, 1978, and 1981. These fluctuations are consistent with data from monitoring programs conducted by TVA at other nuclear power plant sites.

Table 5 presents the maximum permissible concentrations (MPC) specified in 10 CFR 20 for nonoccupational exposure.

BEST COPY AVAILABLE

Rainwater is collected and analyzed monthly for specific gamma-emitting isotopes and strontium. In addition, samples from one of the control stations, which is also a part of the Sequoyah Nuclear Plant (SQN) monitoring program, were also analyzed for gross beta and tritium activity. For the gross beta analysis, a maximum of 500 ml of the sample is boiled to dryness and counted. A gamma scan is performed on a 3.5-liter monthly sample. The strontium isotopes are separated chemically and counted in a low background system. The results are shown in table 7. During this report period one sample was not available for analysis because of equipment malfunction.

The gummed acetate that is used to collect heavy particle fallout is changed monthly. The samples are ashed and counted for gross beta activity. The results are given in table 8.

Charcoal filters are collected weekly and analyzed for radioiodine. The filter is counted in a single channel analyzer system. The data are shown in table 9. During this report period equipment testing was conducted at two local monitoring stations (LM-1 WB and LM-2 WB) resulting in seven samples not being collected for analysis. Ten samples were not collected because of equipment malfunction, one filter was damaged and unusable, another was destroyed inadvertently during processing and two filters were not collected because of hazardous conditions and station inaccessibility.

An atmospheric moisture collection device containing molecular sieve is located at each local monitor and at one remote monitor. Samples are taken every other week, the moisture driven off the molecular sieve, collected in a cold trap, distilled, and counted for tritium content. The results are shown in table 10. During this reporting period, six samples were not obtained because of equipment malfunction, one sample was lost during analysis, and five samples contained insufficient volume for analysis.

BEST COPY AVAILABLE

Table 5

MAXIMUM PERMISSIBLE CONCENTRATIONS

FOR NONOCCUPATIONAL EXPOSURE

	MPC	
	In Water pCi/l*	In Air pCi/m^3*
Alpha	30	
Nonvolatile beta	3,000	100
Tritium	3,000,000	200,000
^{137}Cs	20,000	500
^{103,106}Ru	10,000	200
^{144}Ce	10,000	200
^{95}Zr-^{95}Nb	60,000	1,000
^{140}Ba-^{140}La	20,000	1,000
^{131}I	300	100
^{65}Zn	100,000	2,000
^{54}Mn	100,000	1,000
^{60}Co	30,000	300
^{89}Sr	3,000	300
^{90}Sr	300	30
^{51}Cr	2,000,000	80,000
^{134}Cs	9,000	400
^{58}Co	90,000	2,000
^{59}Fe	50,000	2,000

*1 pCi = 3.7 x 10^{-2} Bq.

BEST COPY AVAILABLE

TABLE 6

RADIOACTIVITY IN AIR FILTER

PCI/M(3) - 0.037 BQ/M(3)

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391

LOCATION OF FACILITY SPRA TENNESSEE — REPORTING PERIOD 1993

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION[a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE[b]	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F)[b] RANGE[b]	CONTROL LOCATIONS MEAN (F)[b] RANGE[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA	0.010	0.03(395/ 405)	PM1 PETTY FARM	0.03(51/ 51)	0.02(95/ 104)	
509		0.01- 0.11	3.75 MILES WSW	0.01- 0.11	0.01- 0.05	
GAMMA (GELI)						
136						
K-40	NOT ESTAB	0.02(73/ 109)	PM1 PETTY FARM	0.02(10/ 13)	0.02(20/ 27)	
		0.00- 0.04	3.75 MILES WSW	0.00- 0.03	0.00- 0.04	
PB-212	NOT ESTAB	0.00(51/ 109)	PM3 CEDINE BIBLE	0.00(4/ 13)	0.00(14/ 27)	
		0.00- 0.00	CAMP 11.5 M. NNE	0.00- 0.00	0.00- 0.00	
RA-226	NOT ESTAB	0.01(1/ 109)	LM2 N. WBSP GATE	0.01(1/ 14)	0.01(2/ 27)	
		0.01- 0.01	0.5 MILES N	0.01- 0.01	0.00- 0.01	
BE-7	0.050	0.07(83/ 109)	LM2 N. WBSP GATE	0.08(9/ 14)	0.06(15/ 27)	
		0.05- 0.13	0.5 MILES N	0.05- 0.12	0.05- 0.09	
TL-208	NOT ESTAB	0.00(28/ 109)	PM6 GOODFIELD	0.00(5/ 14)	0.00(4/ 27)	
		0.00- 0.00	9.0 MILES SSW	0.00- 0.00	0.00- 0.00	
AC-228	NOT ESTAB	0.00(14/ 109)	PM5 DECATUR	0.00(4/ 14)	27 VALUES <LLD	
		0.00- 0.01	6.25 MILES S	0.00- 0.01		
SR 89	0.005	0.01(2/ 31)	PM3 CEDINE BIBLE	0.01(1/ 4)	8 VALUES <LLD	
39		0.01- 0.01	CAMP 11.5 M. NNE	0.01- 0.01		
SR 90	0.001	31 VALUES <LLD			8 VALUES <LLD	
39		ANALYSIS PERFORMED				

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.

b. Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).

BLANK PAGE

BLANK PAGE

BLANK PAGE

TABLE 7

RADIOACTIVITY IN RAINWATER

PCI/L - 0.037 BQ/L

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY DAYTON TENNESSEE — REPORTING PERIOD 1983

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD)[a]	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE[b]	LOCATION WITH HIGHEST ANNUAL MEAN NAME, DISTANCE AND DIRECTION	MEAN (F)[b] RANGE[b]	CONTROL LOCATIONS MEAN (F)[b] RANGE[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA 14	2.400				12.33(4/ 14) 3.84- 35.60	
GAMMA (GELI) 131						
K-40	NOT ESTAB	23.91(32/ 103) 2.31- 86.89	LM2 N. WBSP GATE 0.5 MILES N	35.41(6/ 13) 5.77- 54.67	23.19(5/ 28) 0.72- 56.19	
BI-214	NOT ESTAB	3.97(29/ 103) 0.06- 13.24	PM3 CEDINE BIBLE CAMP 11.5 M. NNE	7.92(2/ 13) 2.59- 13.24	5.13(5/ 28) 1.62- 11.28	
PB-214	NOT ESTAB	2.98(10/ 103) 0.62- 6.32	LM1 ENV DATA STA 0.5 MILES SSW	6.32(1/ 12) 6.32- 6.32	1.44(3/ 28) 0.20- 2.15	
PB-212	NOT ESTAB	2.14(40/ 103) 0.00- 8.77	PM2 SPRING CITY 7.0 MILES NW	3.62(5/ 13) 1.25- 7.56	1.39(10/ 28) 0.09- 3.25	
BE-7	NOT ESTAB	53.34(35/ 103) 26.56- 183.81	PM4 TEN MILE 7.75 MILES NE	78.97(6/ 13) 29.39- 183.81	46.83(14/ 28) 27.65- 62.49	
SR 89 131	10.000	34.62(3/ 103) 14.59- 71.40	PM4 TEN MILE 7.75 MILES NE	71.40(1/ 13) 71.40- 71.40	28 VALUES <LLD	
SR 90 131	2.000	4.84(3/ 103) 2.52- 7.60	PM5 DECATUR 6.25 MILES S	7.60(1/ 13) 7.60- 7.60	28 VALUES <LLD	
TRITIUM 14	330.000				367.61(1/ 14) 367.61- 367.61	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).

15

BEST COPY AVAILABLE

TABLE 8

RADIOACTIVITY IN HEAVY PARTICLE FALLOUT

MCI/KM(2) - 37000000.00 BQ/KM(2)

NAME OF FACILITY WATTS BAR DOCKET NO. 50-390,391
LOCATION OF FACILITY DECATUR TENNESSEE REPORTING PERIOD 1983

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION [a]	ALL INDICATOR LOCATIONS MEAN (F) [b] RANGE [b]	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) [b] RANGE [b]	CONTROL LOCATIONS MEAN (F) [b] RANGE [b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA 130	0.050	0.14(102/ 104) 0.05- 0.41	LM2 N. WBSP GATE 0.5 MILES N	0.27(13/ 13) 0.18- 0.41	0.11(25/ 26) 0.06- 0.23	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).

TABLE 9

RADIOACTIVITY IN CHARCOAL FILTERS

PCI/M(3) - 0.037 BQ/M(3)

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY DAYTON TENNESSEE — REPORTING PERIOD 1983

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION [a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F) [b] RANGE [b]	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) [b] RANGE [b]	CONTROL LOCATIONS MEAN (F) [b] RANGE [b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
IODINE-131	0.020	0.02(38/ 406)	PMS DECATUR	0.02(5/ 53)	0.02(15/ 103)	
509		0.02- 0.03	6.25 MILES S	0.02- 0.03	0.02- 0.03	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).

17

BEST COPY AVAILABLE

TABLE 10

RADIOACTIVITY IN ATMOSPHERIC MOISTURE

PCI/M(3) - 0.037 BQ/M(3)

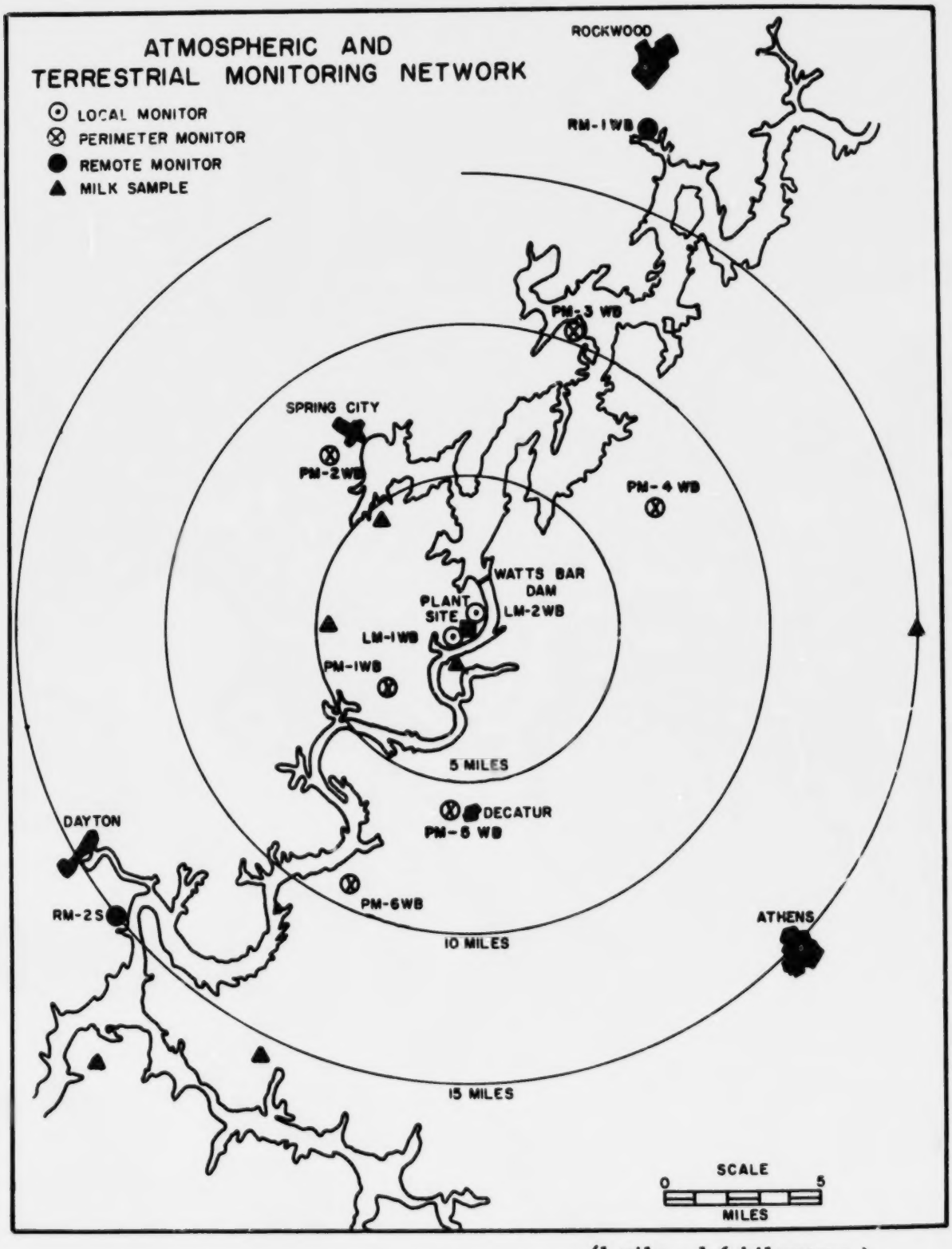
NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY DAYTON TENNESSEE — REPORTING PERIOD 1983

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) [a]	ALL INDICATOR LOCATIONS MEAN (F) [b] RANGE [b]	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) [b]	RANGE [b]	CONTROL LOCATIONS MEAN (F) [b] RANGE [b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
TRITIUM	NOT ESTAB	2.53(41/ 43)	LM2 N. WBSP GATE	2.76(19/ 20)		2.73(22/ 23)	
66		0.31- 6.64	0.5 MILES N	0.84- 6.64		0.17- 12.98	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).

18

Figure 2



(1 mile - 1.6 kilometers)

BEST COPY AVAILABLE

BEST COPY AVAILABLE

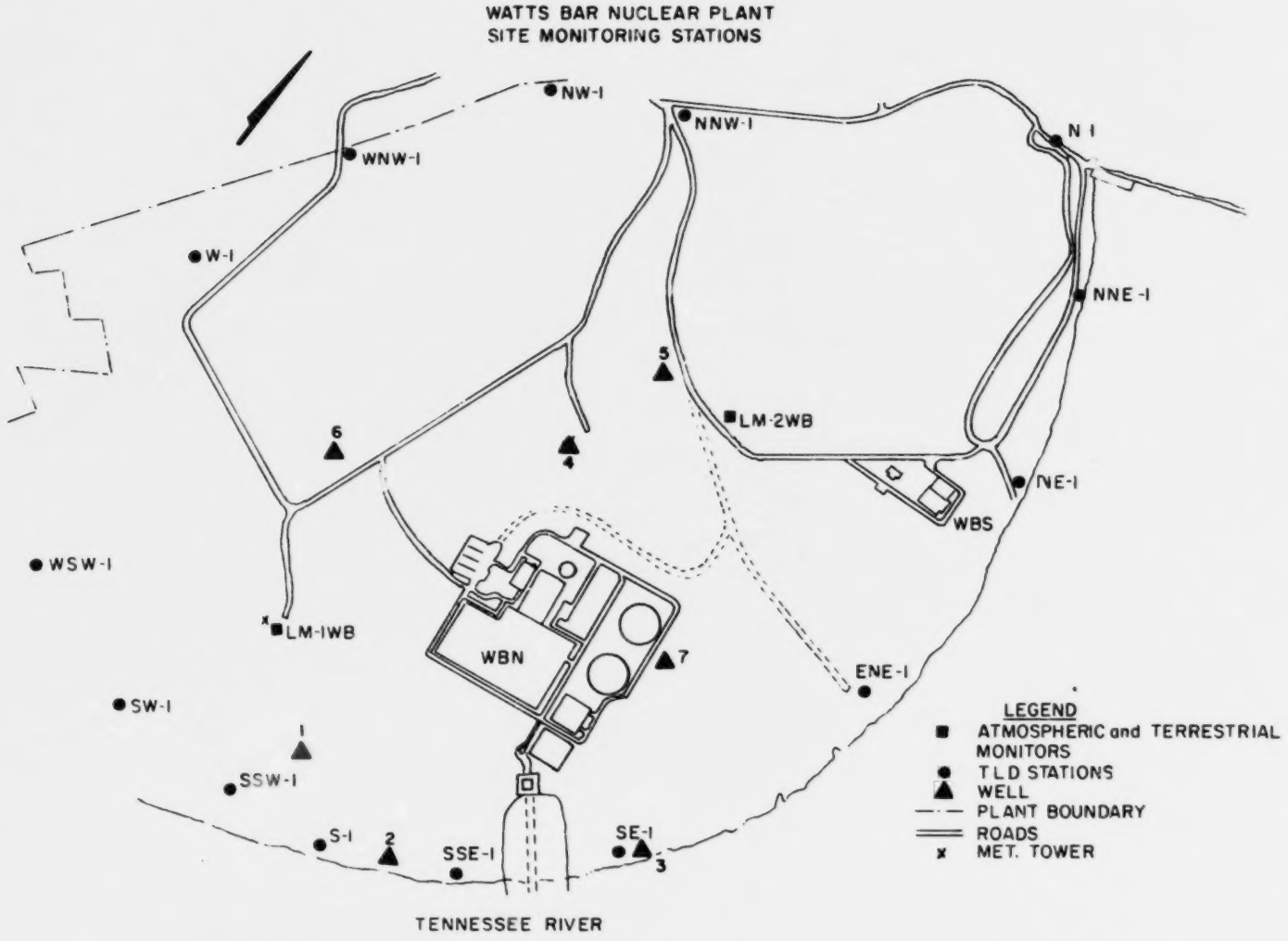


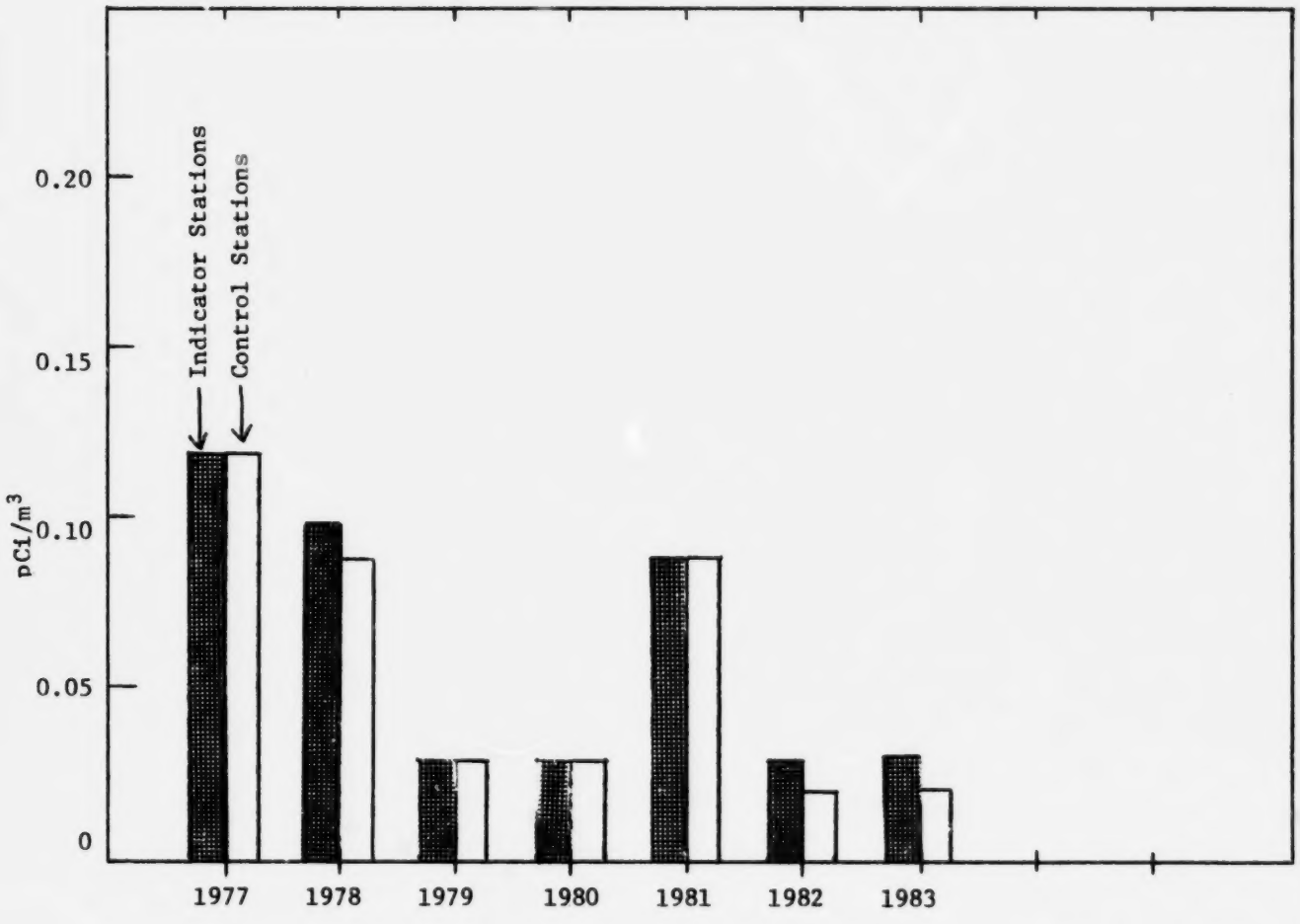
Figure 3

Figure 4

Annual Average

Gross Beta Activity in Air (Particulate Filters)

Watts Bar Nuclear Plant



BEST COPY AVAILABLE

THIS PAGE

INTENTIONALLY LEFT

BLANK

BEST COPY AVAILABLE

Terrestrial Monitoring

Milk

Milk samples were collected monthly from three indicator stations. Weekly samples were taken at three control stations (these control stations are part of an ongoing SQN sampling program). All monthly and weekly samples and composites are analyzed for I-131. Monthly samples are also analyzed for gamma-emitting radionuclides and strontium. Table 11 gives the results of laboratory analysis. During this report period one sample was inadvertently destroyed during processing resulting in the loss of one gamma analyses. One weekly sample was not available for collection.

As has been noted in previous radiological monitoring reports, the levels of ^{90}Sr in milk samples from farms producing milk for private consumption only are up to six times the levels found in milk from commercial dairy farms. Samples of feed and water supplied to the animals were analyzed in 1979 in an effort to determine the source of the strontium. Analysis of dried hay samples indicated levels of ^{90}Sr slightly higher than those encountered in routine vegetation samples. Analysis of pond water indicated no significant strontium activity.

This phenomenon was observed during preoperational radiological monitoring near Sequoyah and Bellefonte Plants at farms where only one or two cows were being milked for private consumption of the milk. A similar phenomenon has been observed at two small dairy farms near the Watts Bar Nuclear Plant. Levels reported for 1983 are about a factor of 2 above the levels measured at larger dairy farms. It is postulated that the feeding practices of these small farmers differ from those of the larger dairy farmers to the extent that fallout from atmospheric nuclear weapons testing may be more concentrated in these instances. Similarly, Hansen, et al., reported an inverse relationship between the levels of ^{90}Sr in milk and the quality of fertilization and land management.[a]

Vegetation

Vegetation samples were collected quarterly from the farms from which milk was collected and were analyzed for gamma-emitting radionuclides, ^{89}Sr, and ^{90}Sr content. The sampling frequency was monthly at the three control stations in support of the SQN monitoring program. These monthly samples were analyzed for gamma-emitting radionuclides. The monthly samples collected at the end of each quarter were also analyzed for strontium content. Approximately 1-2 kilograms of grass was broken or cut at ground level and returned for analysis. Efforts were made to sample vegetation that was representative of the pasturage where cattle graze. Table 12 gives the results obtained from the laboratory analyses.

Soil

Soil samples were collected semiannually near each monitoring station and from one control station used in the Sequoyah monitoring program.

---

[a] Hansen, W. G., et al., Farming Practices and Concentrations of Emission Products in Milk, U.S. Department of Health, Education, and Welfare; Public Health Service Publication No. 999-R-6, May 1964.

An additional sample was taken at the Sequoyah monitoring station. Soil samples are taken to provide an indication of any long-term buildup of radioactivity in the environment. An auger or "cookie cutter" type of sampler was used to obtain samples of the top two inches (5 cm) of soil. All samples were analyzed for gross beta activity, gamma-emitting radionuclides, and strontium content. The analytical results are given in table 13.

Ground Water

Well water was obtained monthly from three farms in the area and from six onsite wells. For five months an automatic sequential-type sampling device was operating on a seventh well located downgradient from WBN. During June the well was deactivated and the sampler was moved to another onsite well. All samples were analyzed for gamma-emitting radionuclides and a quarterly composite was analyzed for tritium. The results are shown in table 14. During this reporting period, five samples were not taken because two of the stations were inaccessible for a period of time due to ground conditions.

Public Water

Potable water supplies taken from the Tennessee River in the vicinity of WBN were sampled and analyzed monthly for gross beta and gamma-emitting radionuclides. Tritium, ^{89}Sr, and ^{90}Sr concentrations are determined in quarterly composite samples. The potable water sampling locations downstream from the plant are equipped with automatic samplers with composite samples analyzed monthly. Results of laboratory analysis are shown in table 15.

Figure 5 shows the trends in gross beta activity in drinking water from 1977 through 1983. The annual averages for the indicator stations reported herein are slightly higher than the levels reported in surface water samples (figure 6).

Environmental Gamma Radiation Levels

Bulb-type Victoreen manganese-activated calcium fluoride (CaF_2: Mn) thermoluminescent dosimeters (TLDs) are placed at 16 stations around the plant near the site boundary, at the perimeter and remote air monitors, and at 22 additional stations approximately 5 miles from the site to determine the gamma exposure rates at these locations. The dosimeters, in energy compensating shields to correct energy dependence, are placed at approximately one meter above the ground, with three TLDs at each station. They are annealed and read with a Victoreen Model 2810 TLD reader. The values are corrected for gamma response, self-irradiation, and fading, with individual gamma response calibrations and self-irradiation factors determined for each TLD. The TLDs are exchanged every three months. The quarterly gamma radiation levels determined from these TLDs are given in table 16, which indicates that average levels at onsite stations are approximately 2-3 mR/quarter higher than levels at offsite stations. This is consistent

BEST COPY AVAILABLE

with levels reported in other preoperational radiological monitoring programs conducted by TVA where the average radiation levels onsite are generally 2-6 mR/quarter higher than levels offsite. The causes of these differences have not been completely isolated; however, it is postulated that the differences are probably attributable to combinations of influences, such as natural variations in environmental radiation levels, earth moving activities onsite, the mass of concrete employed in the construction of the plant, or other undetermined influences.

Figure 8 compares plots of the data from the onsite or site boundary stations with those from the offsite stations over the period from 1977 through 1983. To reduce the variations present in the data sets, a four-quarter moving average was constructed for each set. Figure 9 presents a trend plot of the direct radiation levels as defined by the moving averages. The data follow the same general trend as the raw data, but the curves are smoothed considerably.

Food Crops, Beef, and/or Poultry

Food crops, beef, and/or poultry raised in the vicinity of WBN are sampled annually as they become available during the growing season. During this sampling period, samples of apples, cabbage, corn, green beans, potatoes, and tomatoes were collected and analyzed for gross beta and specific gamma-emitting radionuclides. The results are given in tables 17 through 22. One potato and one tomato sample was inadvertently destroyed during processing and a beta analysis was not done. Beef and poultry samples were collected and analyzed for gamma-emitting radionuclides. Analytical results are given in tables 23 and 24.

TABLE 11

RADIOACTIVITY IN MILK

PCI/L - 0.037 BQ/L

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY DECATUR TENNESSEE — REPORTING PERIOD 1983

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) [a]	ALL INDICATOR LOCATIONS MEAN (F) [b] RANGE	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) [b] RANGE	CONTROL LOCATIONS MEAN (F) [b] RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
IODINE-131 197	0.500	39 VALUES <LLD ANALYSIS PERFORMED			158 VALUES <LLD	
GAMMA (GELI) 77						
CS-137	5.000	5.66(2/ 36)	HOUSLEY FARM	5.66(2/ 13)	39 VALUES <LLD	
		5.13- 6.18	4.75 MILES W	5.13- 6.18		
K-40	NOT ESTAB	1349.91(38/ 38)	LAYMAN FARM	1380.09(13/ 13)	1334.27(39/ 39)	
		1109.89- 1659.53	1.5 MILES SSW	1217.02- 1659.53	1101.09- 1513.09	
BI-214	NOT ESTAB	5.97(16/ 36)	HOUSLEY FARM	7.24(6/ 13)	10.21(23/ 39)	
		0.80- 14.13	4.75 MILES W	1.11- 14.13	0.34- 32.68	
PB-214	NOT ESTAB	7.17(6/ 38)	HOUSLEY FARM	8.20(2/ 13)	11.34(12/ 39)	
		4.53- 11.71	4.75 MILES W	4.70- 11.71	0.07- 30.83	
PB-212	NOT ESTAB	2.23(15/ 38)	HOUSLEY FARM	3.15(6/ 13)	1.92(13/ 39)	
		0.14- 5.36	4.75 MILES W	0.41- 5.36	0.05- 5.07	
TL-208	NOT ESTAB	2.17(6/ 38)	HOUSLEY FARM	2.96(1/ 13)	2.32(7/ 39)	
		0.66- 3.04	4.75 MILES W	2.98- 2.98	0.24- 5.87	
AC-228	NOT ESTAB	5.56(2/ 38)	MOFFETT FARM	7.38(1/ 12)	39 VALUES <LLD	
		3.74- 7.38	4.5 MILES NW	7.38- 7.38		
SR 89	10.000	18.21(1/ 39)	HOUSLEY FARM	18.21(1/ 13)	39 VALUES <LLD	
78		18.21- 18.21	4.75 MILES W	18.21- 18.21		
SR 90	2.000	6.63(32/ 39)	MOFFETT FARM	7.28(13/ 13)	3.08(26/ 39)	
78		2.50- 11.90	4.5 MILES NW	5.06- 11.60	2.08- 5.37	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).

TABLE 12

RADIOACTIVITY IN VEGETATION

PCI/G - 0.037 BQ/G (DRY WEIGHT)

NAME OF FACILITY [illegible] JOCKET NO. 50-390,391

LOCATION OF FACILITY [illegible] TENNESSEE REPORTING PERIOD 1983

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED		LOWER LIMIT OF DETECTION[a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE	LOCATION WITH HIGHEST ANNUAL MEAN NAME	MEAN (F)[b]	RANGE[b]	CONTROL LOCATIONS MEAN (F)[b] RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GAMMA (GELI)	51							
CS-137		0.060	10 VALUES <LLD				0.09(2/ 39)	
							0.06- 0.12	
K-40		NOT ESTAB	15.[illegible](12/ 12)	MOFFETT FARM	16.41(4/ 4)		19.70(39/ 39)	
			8.24- 27.17	4.5 MILES NW	9.53- 27.17		2.50- 37.12	
BI-214		0.100	0.25(1/ 12)	MOFFETT FARM	0.23(1/ 4)		0.13(5/ 39)	
			0.23- 0.23	4.5 MILES NW	0.23- 0.23		0.11- 0.15	
PI-212		NOT ESTAB	12 VALUES <LLD				0.70(1/ 39)	
							0.70- 0.70	
PB-214		NOT ESTAB	0.05(4/ 12)	MOFFETT FARM	0.07(2/ 4)		0.08(19/ 39)	
			0.01- 0.11	4.5 MILES NW	0.03- 0.11		0.00- 0.20	
PB-212		NOT ESTAB	0.04(7/ 12)	MOFFETT FARM	0.06(2/ 4)		0.08(33/ 39)	
			0.02- 0.09	4.5 MILES NW	0.02- 0.09		0.00- 0.37	
BE-7		NOT ESTAB	7.24(12/ 12)	LAYMAN FARM	8.57(4/ 4)		6.44(39/ 39)	
			1.29- 14.15	1.5 MILES SSW	5.47- 11.20		1.05- 13.93	
TL-208		NOT ESTAB	0.01(2/ 12)	MOFFETT FARM	0.02(1/ 4)		0.04(22/ 39)	
			0.01- 0.02	4.5 MILES NW	0.02- 0.02		0.00- 0.17	
AC-228		NOT ESTAB	0.16(2/ 12)	MOFFETT FARM	0.25(1/ 4)		0.14(9/ 39)	
			0.16- 0.25	4.5 MILES NW	0.25- 0.25		0.00- 0.20	
SR 89		0.250	12 VALUES <LLD				0.40(2/ 12)	
	24						0.32- 0.48	
SR 90		0.050	0.16(10/ 12)	MOFFETT FARM	0.19(3/ 4)		0.18(11/ 12)	
	24		0.07- 0.27	4.5 MILES NW	0.14- 0.24		0.05- 0.44	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.

b. Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).

BEST COPY AVAILABLE

TABLE 13

RADIOACTIVITY IN SOIL

PCI/G - 0.037 BQ/G (DRY WEIGHT)

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY ROANE TENNESSEE — REPORTING PERIOD 1983

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION [a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F) [b] RANGE [b]	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) [b]	RANGE [b]	CONTROL LOCATIONS MEAN (F) [b] RANGE [b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA	0.700	31.10(16/ 16)	PM2 SPRING CITY	51.25(	2/ 2)	17.83(5/ 5)	
21		12.61- 67.06	7.0 MILES NW	39.44-	63.06	9.95- 30.03	
GAMMA (GELI)							
21							
CO-60	0.010	0.10(1/ 16)	PM2 SPRING CITY	0.10(	1/ 2)	5 VALUES <LLD	
		0.10- 0.10	7.0 MILES NW	0.10-	0.10		
CS-137	0.020	0.58(16/ 16)	PM5 DECATUR	1.02(	2/ 2)	0.25(5/ 5)	
		0.15- 1.36	6.25 MILES S	0.68-	1.36	0.19- 0.37	
K-40	0.250	9.05(16/ 16)	PM2 SPRING CITY	19.78(	2/ 2)	3.91(5/ 5)	
		2.86- 22.01	7.0 MILES NW	17.36-	22.01	2.52- 6.20	
BI-214	0.050	0.88(16/ 16)	LM2 N. WBSP GATE	1.17(	2/ 2)	0.91(5/ 5)	
		0.61- 1.58	0.5 MILES N	0.76-	1.58	0.64- 1.35	
BI-212	0.100	1.15(16/ 16)	LM1 ENV DATA STA	1.42(	2/ 2)	0.82(5/ 5)	
		0.66- 1.66	0.5 MILES SSW	1.34-	1.50	0.56- 1.22	
PB-214	0.050	0.99(16/ 16)	LM2 N. WBSP GATE	1.33(	2/ 2)	1.02(5/ 5)	
		0.73- 1.78	0.5 MILES N	0.87-	1.78	0.70- 1.56	
PB-212	NOT ESTAB	1.05(16/ 16)	LM2 N. WBSP GATE	1.34(	2/ 2)	0.72(5/ 5)	
		0.36- 1.66	0.5 MILES N	1.02-	1.66	0.51- 1.13	
RA-226	0.050	0.88(16/ 16)	LM2 N. WBSP GATE	1.17(	2/ 2)	0.91(5/ 5)	
		0.61- 1.58	0.5 MILES N	0.76-	1.58	0.64- 1.35	
RA-223	NOT ESTAB	0.33(3/ 16)	PM1 PETTY FARM	0.35(	1/ 2)	0.32(1/ 5)	
		0.31- 0.35	3.75 MILES WSW	0.35-	0.35	0.32- 0.32	
RA-224	NOT ESTAB	1.02(15/ 16)	LM1 ENV DATA STA	1.32(	2/ 2)	0.84(5/ 5)	
		0.57- 1.34	0.5 MILES SSW	1.32-	1.32	0.54- 1.13	
TL-208	0.020	0.36(16/ 16)	LM2 N. WBSP GATE	0.47(	2/ 2)	0.25(5/ 5)	
		0.19- 0.57	0.5 MILES N	0.37-	0.57	0.17- 0.37	
AC-228	0.060	1.07(16/ 16)	LM2 N. WBSP GATE	1.35(	2/ 2)	0.76(5/ 5)	
		0.60- 1.62	0.5 MILES N	1.06-	1.62	0.55- 1.18	
PA-234M	NOT ESTAB	2.57(5/ 16)	PM2 SPRING CITY	3.78(	1/ 2)	2.09(1/ 5)	
		1.55- 3.78	7.0 MILES NW	3.78-	3.78	2.09- 2.09	
SR 89	1.500	1.63(4/ 16)	PM6 GOODFIELD	1.75(	1/ 2)	4.38(1/ 5)	
21		1.50- 1.75	9.0 MILES SSW	1.75-	1.75	4.38- 4.38	
SR 90	0.300	0.51(1/ 16)	PM6 GOODFIELD	0.51(	1/ 2)	5 VALUES <LLD	
21		0.51- 0.51	9.0 MILES SSW	0.51-	0.51		

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).

28

TABLE 14

RADIOACTIVITY IN WELL WATER

PCI/L - 0.037 BQ/L

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY DECATUR TENNESSEE — REPORTING PERIOD 1993

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION[a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE[b]	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F)[b] RANGE[b]	CONTROL LOCATIONS MEAN (F)[b] RANGE[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GAMMA (GELI) 119						
K-40	NOT ESTAB	21.89(25/ 80) 1.07- 55.95	WBN WELL #2 ONSITE SSE	34.02(5/ 11) 10.84- 51.73	28.23(13/ 39) 4.33- 56.34	
BI-214	NOT ESTAB	4.58(25/ 80) 0.53- 12.30	WBN WELL #3 ONSITE SE	11.53(1/ 10) 11.53- 11.58	62.15(25/ 39) 0.41- 531.61	
PB-214	NOT ESTAB	4.39(13/ 80) 1.92- 9.34	WBN WELL #4 ONSITE NNW	8.49(1/ 13) 8.49- 8.49	74.62(20/ 39) 0.00- 525.91	
PB-212	NOT ESTAB	1.53(25/ 80) 0.01- 4.77	WBN WELL #5 ONSITE N	2.67(3/ 13) 0.93- 4.77	1.60(10/ 39) 0.05- 4.38	
TL-208	NOT ESTAB	1.36(11/ 80) 0.22- 2.71	WBN WELL #1 ONSITE S	2.71(1/ 14) 2.71- 2.71	1.18(8/ 39) 0.08- 3.34	
AC-228	NOT ESTAB	5.01(2/ 80) 1.30- 8.73	WBN WELL #1 ONSITE S	8.73(1/ 14) 8.73- 8.73	1.93(2/ 39) 1.27- 2.60	
TRITIUM 39	330.000	27 VALUES <LLD ANALYSIS PERFORMED			12 VALUES <LLD	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).

BEST COPY AVAILABLE

TABLE 15

RADIOACTIVITY IN PUBLIC WATER SUPPLY

PCI/L - 0.037 BQ/L

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391

LOCATION OF FACILITY SWEA, TENNESSEE — REPORTING PERIOD 1981

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION[a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE[b]	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F)[b]	RANGE[b]	CONTROL LOCATIONS MEAN (F)[b] RANGE[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA	2.400	4.23(13/ 27)	DAYTON, TN	4.43(10/ 14)		26 VALUES <LLD	
53		2.41- 12.63	17.75 MILES NNE	2.41- 12.63			
GAMMA (GELI)							
53							
K-40	NOT ESTAB	11.90(8/ 27)	DAYTON, TN	12.05(4/ 14)		17.30(10/ 26)	
		0.92- 31.89	17.75 MILES NNE	0.92- 31.89		2.30- 48.40	
BI-214	NOT ESTAB	3.50(12/ 27)	CF INDUSTRIES	4.77(4/ 13)		8.59(19/ 26)	
		0.99- 8.80	TRM 473.0	1.32- 8.80		0.06- 37.67	
PB-214	NOT ESTAB	2.52(6/ 27)	CF INDUSTRIES	3.64(3/ 13)		9.72(13/ 26)	
		0.45- 5.72	TRM 473.0	1.67- 5.72		0.78- 30.36	
PB-212	NOT ESTAB	1.72(11/ 27)	DAYTON, TN	2.42(5/ 14)		1.76(9/ 26)	
		0.18- 3.74	17.75 MILES NNE	1.44- 3.74		0.64- 3.67	
TL-208	NOT ESTAB	1.10(4/ 27)	CF INDUSTRIES	1.12(3/ 13)		1.70(3/ 26)	
		0.62- 1.76	TRM 473.0	0.62- 1.76		1.04- 2.48	
AC-228	NOT ESTAB	27 VALUES <LLD				9.39(1/ 26)	
						9.89- 9.39	
SR 89	10.000	9 VALUES <LLD				8 VALUES <LLD	
17		ANALYSIS PERFORMED					
SR 90	2.000	9 VALUES <LLD				8 VALUES <LLD	
17		ANALYSIS PERFORMED					
TRITIUM	330.000	359.06(1/ 9)	CF INDUSTRIES	359.06(1/ 4)		3 VALUES <LLD	
17		359.06- 359.06	TRM 473.0	359.06- 359.06			

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.

b. Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).

Table 16

ENVIRONMENTAL GAMMA RADIATION LEVELS

Average External Gamma Radiation Levels at Various Distances from Watts Bar Nuclear Plant for Each Quarter - 1983
mR/Quarter[a]

Distance miles	Average External Gamma Radiation Levels[b]			
	1st Quarter (Dec 82-Feb 83)	2nd Quarter (Mar-May 83)	3rd Quarter (Jun-Aug 83)	4th Quarter (Sep-Nov 83)
0-1	17.8 ± 3.5	19.1 ± 3.3	20.1 ± 2.1	20.9 ± 2.5
1-2	16.3 ± 3.1	19.1 ± 1.8	22.0 ± 1.0	20.5 ± 2.1
2-4	12.8 ± 0.5	19.8 ± 7.1	17.1 ± 1.0	17.4 ± 0.3
4-6	14.4 ± 2.6	16.8 ± 2.5	18.9 ± 2.7	18.1 ± 3.1
>6	13.7 ± 3.2	15.0 ± 2.7	17.1 ± 3.4	17.2 ± 3.4
Average, 0-2 miles (Onsite)	17.3 ± 3.3	19.1 ± 2.8	21.1 ± 1.9	20.7 ± 2.3
Average, >2 miles (Offsite)	14.0 ± 2.1	16.3 ± 3.2	18.1 ± 3.0	17.7 ± 3.1

a. Data normalized to one quarter (2190 hours).
b. All averages reported ±1σ (68 percent confidence level).

BEST COPY AVAILABLE

BLANK PAGE

BLANK PAGE

BLANK PAGE

TABLE 17

RADIOACTIVITY IN APPLES

PCI/KG - 0.037 BQ/KG (WET WT)

NAME OF FACILITY BAIIS BAR — DOCKET NO. 50-390,391

LOCATION OF FACILITY BOWEN TENNESSEE — REPORTING PERIOD 1983

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION[a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE[b]	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F)[b] RANGE[b]	CONTROL LOCATIONS MEAN (F)[b] RANGE[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA 2	NOT ESTAB	2013.22(1/ 1) 2013.22- 2013.22	4.5 MILES NW	2013.22(1/ 1) 2013.22- 2013.22	2298.00(1/ 1) 2298.00- 2298.00	
GAMMA (GELI) 2						
K-40	NOT ESTAB	978.31(1/ 1) 978.31- 978.31	4.5 MILES NW	978.31(1/ 1) 978.31- 978.31	1812.76(1/ 1) 1812.76- 1812.76	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.

b. Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).

TABLE 18

RADIOACTIVITY IN CABBAGE

PCI/KG - 0.037 BQ/KG (WET WEIGHT)

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391

LOCATION OF FACILITY SHEA TENNESSEE — REPORTING PERIOD 1983

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION[a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE[b]	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F)[b] RANGE[b]	CONTROL LOCATIONS MEAN (F)[b] RANGE[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA	25.000	3925.82(1/ 1)	4.5 MILES NW	3925.82(1/ 1)	3612.76(1/ 1)	
2		3925.82- 3925.82		3925.82- 3925.82	3612.76- 3612.76	
GAMMA (GELI)						
2						
K-40	NOT ESTAB	2061.53(1/ 1)	4.5 MILES NW	2061.53(1/ 1)	1941.94(1/ 1)	
		2061.53- 2061.53		2061.53- 2061.53	1941.94- 1941.94	
BI-214	NOT ESTAB	3.64(1/ 1)	4.5 MILES NW	3.64(1/ 1)	1 VALUES <LLD	
		3.64- 3.64		3.64- 3.64		
PB-212	NOT ESTAB	1 VALUES <LLD			1.94(1/ 1)	
					1.94- 1.94	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.

b. Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).

BEST COPY AVAILABLE

TABLE 19

RADIOACTIVITY IN CORN

PCI/KG - C.037 BQ/KG (WET WEIGHT)

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY DAYTON TENNESSEE — REPORTING PERIOD 1983

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION[a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE[b]	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F)[b] RANGE[b]	CONTROL LOCATIONS MEAN (F)[b] RANGE[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA 2	25.000	3945.44(1/ 1) 3945.44- 3945.44	4.5 MILES NW	3945.44(1/ 1) 3945.44- 3945.44	3062.59(1/ 1) 3062.59- 3062.59	
GAMMA (GELI) 2						
K-40	NOT ESTAB	2208.60(1/ 1) 2208.60- 2208.60	4.5 MILES NW	2208.60(1/ 1) 2208.60- 2208.60	3103.18(1/ 1) 3103.18- 3103.18	
BI-214	NOT ESTAB	1.20(1/ 1) 1.20- 1.20	4.5 MILES NW	1.20(1/ 1) 1.20- 1.20	1 VALUES <LLD	
PB-214	NOT ESTAB	8.87(1/ 1) 8.87- 8.87	4.5 MILES NW	8.87(1/ 1) 8.87- 8.87	1 VALUES <LLD	
PB-212	NOT ESTAB	1 VALUES <LLD			1.75(1/ 1) 1.75- 1.75	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).

TABLE 20

RADIOACTIVITY IN GREEN BEANS

PCI/KG - 0.037 BQ/KG (WET WEIGHT)

NAME OF FACILITY_WATTS BAR_____ DOCKET NO._50-390,391_____
LOCATION OF FACILITY_DECATUR, TENNESSEE_____ REPORTING PERIOD_1983_____

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION [a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F) [b] RANGE [b]	LOCATION WITH HIGHEST ANNUAL MEAN NAME, DISTANCE AND DIRECTION	MEAN (F) [b] RANGE [b]	CONTROL LOCATIONS MEAN (F) [b] RANGE [b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA 2	25.000	4438.66(1/ 1) 4438.66- 4438.66	4.5 MILES NW	4438.66(1/ 1) 4438.66- 4438.66	5238.54(1/ 1) 5238.54- 5238.54	
GAMMA (GELI) 2						
K-40	NOT ESTAB	1115.71(1/ 1) 1115.71- 1115.71	4.5 MILES NW	1115.71(1/ 1) 1115.71- 1115.71	2601.57(1/ 1) 2601.57- 2601.57	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified locations is indicated in parentheses (F).

BEST COPY AVAILABLE

BEST COPY AVAILABLE

TABLE 21

RADIOACTIVITY IN POTATOES

PCI/KG - 0.037 BQ/KG (WET WEIGHT)

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY DECATUR TENNESSEE — REPORTING PERIOD 1983

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION[a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE[b]	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F)[b] RANGE[b]	CONTROL LOCATIONS MEAN (F)[b] RANGE[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA 1	25.000	6703.89(1/ 1) 6703.89- 6703.89	4.5 MILES NW	6703.89(1/ 1) 6703.89- 6703.89		
GAMMA (GELI) 2						
K-40	NOT ESTAB	4034.04(1/ 1) 4034.04- 4034.04	4.5 MILES NW	4034.04(1/ 1) 4034.04- 4034.04	3118.61(1/ 1) 3118.61- 3118.61	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).

TABLE 22

RADIOACTIVITY IN TOMATOES

PCI/KG - 0.037 Bq/KG (WET WEIGHT)

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY DAYTON TENNESSEE — REPORTING PERIOD 1983

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION[a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE[b]	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F)[b] RANGE[b]	CONTROL LOCATIONS MEAN (F)[b] RANGE[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA 1	25.000	3948.89(1/ 1) 3948.89- 3948.89	4.5 MILES NW	3948.89(1/ 1) 3948.89- 3948.89		
GAMMA (GELI) 2						
K-40	NOT ESTAB	2436.71(1/ 1) 2436.71- 2436.71	4.5 MILES NW	2436.71(1/ 1) 2436.71- 2436.71	1834.11(1/ 1) 1834.11- 1834.11	
PB-214	NOT ESTAB	1 VALUES <LLD			4.06(1/ 1) 4.06- 4.06	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).

BEST COPY AVAILABLE

TABLE

RADIOACTIVITY IN BEEF

PCI/KG - 0.037 BQ/KG (WET WEIGHT)

NAME OF FACILITY [illegible] DOCKET NO. 50-320,321

LOCATION OF FACILITY [illegible] REPORTING PERIOD 1983

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION[a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE[b]	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F)[b] RANGE[b]	CONTROL LOCATIONS MEAN (F)[b] RANGE[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA 2	25.000	1377.09(1/ 1) 1377.09- 1377.09	LAYMAN FARM 1.5 MILES SSW	1377.09(1/ 1) 1377.09- 1377.09	3885.57(1/ 1) 3885.57- 3885.57	
GAMMA (GELI) 2						
K-40	NOT ESTAB	1774.69(1/ 1) 1774.69- 1774.69	LAYMAN FARM 1.5 MILES SSW	1774.69(1/ 1) 1774.69- 1774.69	1624.53(1/ 1) 1624.53- 1624.53	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.

b. Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).

TABLE 24

RADIOACTIVITY IN POULTRY

PCI/KG - 0.037 BQ/KG (WET WEIGHT)

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391

LOCATION OF FACILITY ROANE TENNESSEE — REPORTING PERIOD 1983

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION[a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE[b]	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F)[b] RANGE[b]	CONTROL LOCATIONS MEAN (F)[b] RANGE[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA 2	25.000	5728.08(1/ 1) 5728.08- 5728.08	LAYMAN FARM 1.5 MILES SSW	5728.08(1/ 1) 5728.08- 5728.08	3939.51(1/ 1) 3939.51- 3939.51	
GAMMA (GELI) 2						
K-40	NOT ESTAB	2130.85(1/ 1) 2130.85- 2130.85	LAYMAN FARM 1.5 MILES SSW	2130.85(1/ 1) 2130.85- 2130.85	1530.64(1/ 1) 1530.64- 1530.64	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.

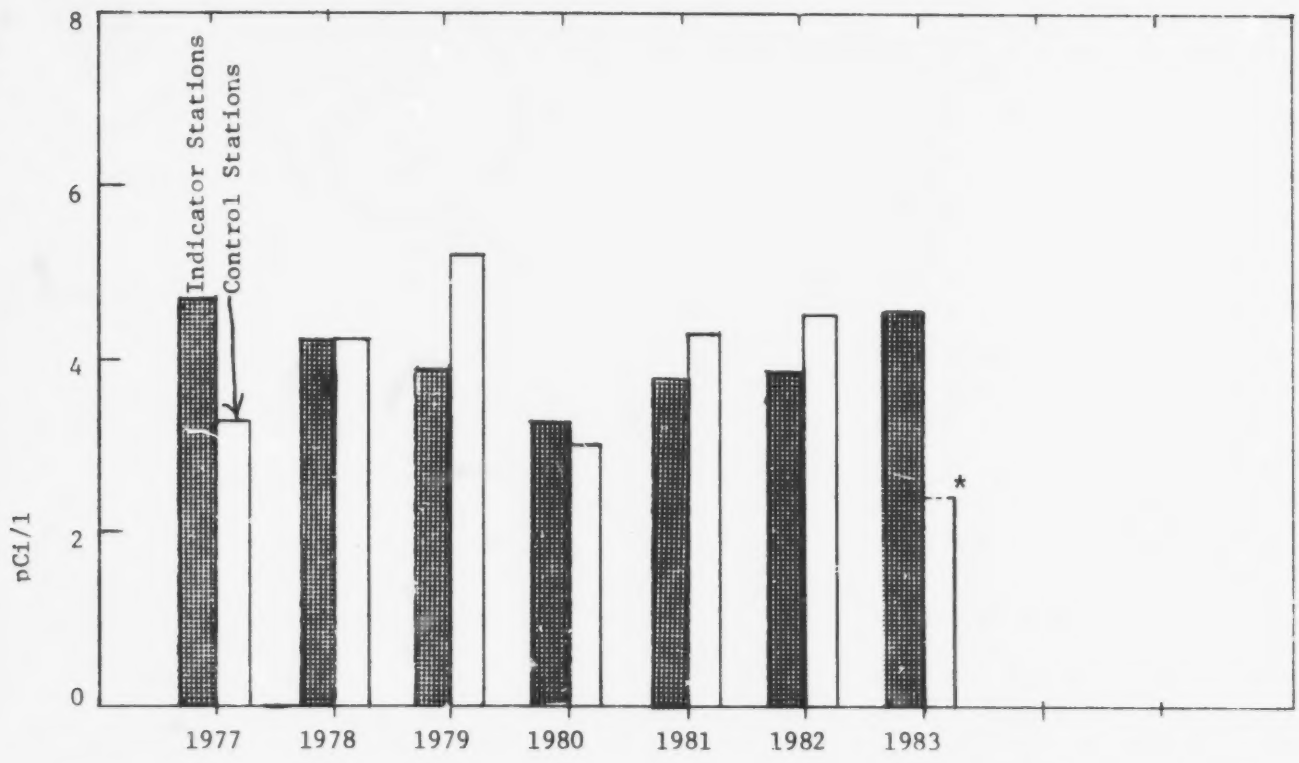
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).

Figure 5

Annual Average

Gross Beta Activity in Drinking Water

Watts Bar Nuclear Plant



*Less than LLD (2.4 pCi/1).

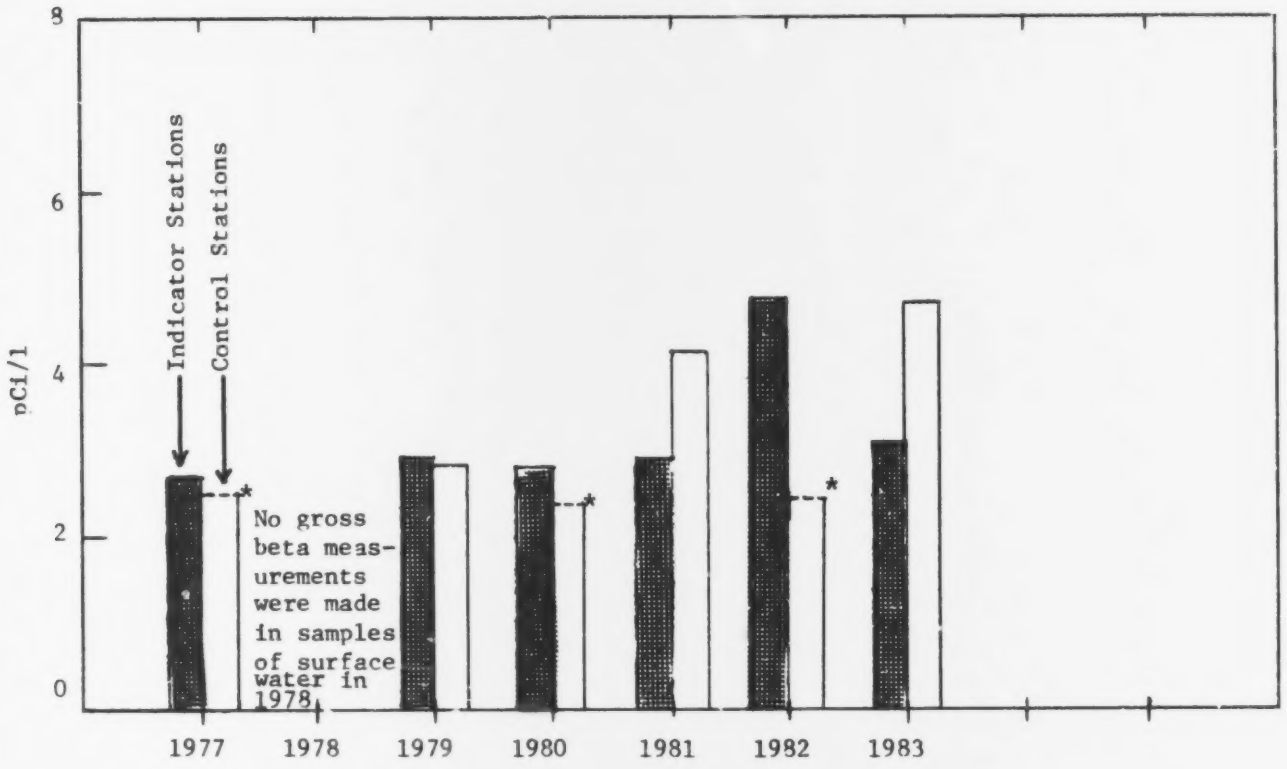
BEST COPY AVAILABLE

Figure 6

Annual Average

Gross Beta Activity in Surface Water

Watts Bar Nuclear Plant



*Less than LLD (2.4 pCi/1).

BEST COPY AVAILABLE

Figure 7

Figure 8

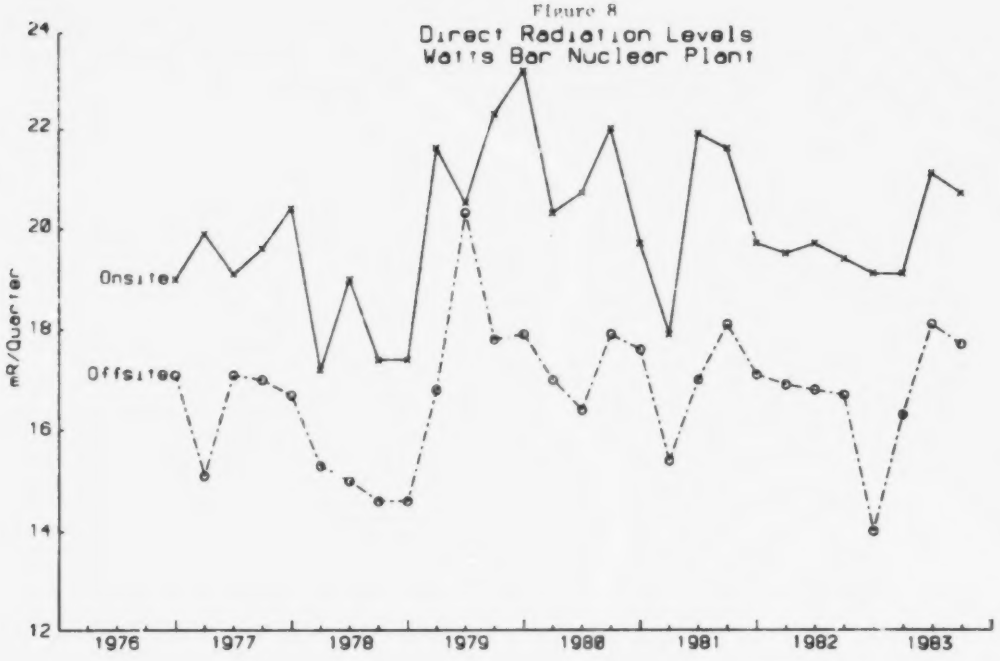
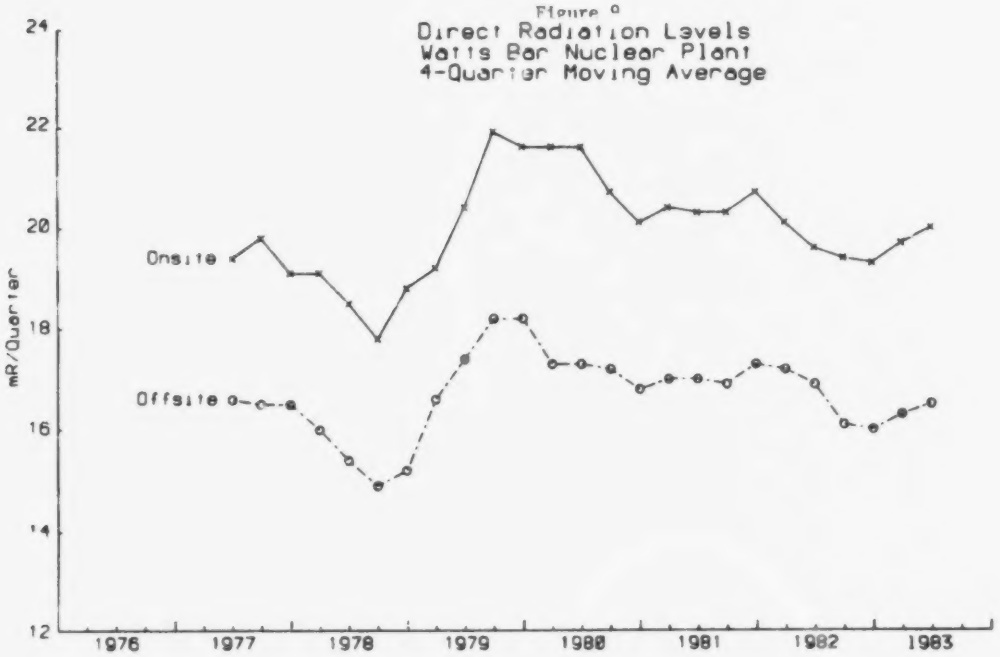


Figure 9



BEST COPY AVAILABLE

THIS PAGE

INTENTIONALLY LEFT

BLANK

BEST COPY AVAILABLE

Reservoir Monitoring

Samples of water and aquatic media are collected quarterly along five river stations in Chickamauga and Watts Bar Reservoirs--at Tennessee River miles (TRM) 496.5, 518.0, 527.4. 529.9, and 532.1. The station at TRM 496.5 is also a part of the Sequoyah Nuclear Plant monitoring. In conjunction with that program, additional analyses are conducted on some samples. Samples collected for radiological analyses include sediment, plankton, and Asiatic clams from four stations; water from three stations; and fish from Watts Bar, Chickamauga and Nickajack Reservoirs (see table 25). The locations of these stations are shown on the accompanying map (figure 10) and conform to sediment ranges established and surveyed by TVA.

Samples of water, net plankton, sediment, and Asiatic clams were collected quarterly and analyzed for radioactivity. In addition, samples of the flesh of two commercial and one game species of fish and the whole body of one commercial fish species were collected and analyzed semiannually.

Water

Grab water samples were collected quarterly from three locations in the Tennessee River; one upstream from the plant discharge area, one immediately downstream from the discharge area, and one approximately nine miles downstream. The samples were analyzed for gross beta activity, gamma-emitting radionuclides, ^{89}Sr, ^{90}Sr, and ^{3}H. Results are displayed in table 26.

Figure 6 presents a plot of the gross beta activity in surface water from 1977 through 1983. Indicator stations are those located downstream from the plant and controls are located upstream. The levels reported are consistent with gross beta levels measured in surface water samples taken from the Tennessee River in preoperational radiological monitoring programs conducted by TVA at other sites.

Fish

Radiological monitoring for fish was accomplished by analyses of composite samples of adult fish taken semiannually from each of three contiguous reservoirs--Watts Bar, Chickamauga, and Nickajack. No permanent sampling stations have been established within each reservoir; this reflects the movement of fish species within reservoirs as determined by TVA data from the Browns Ferry Nuclear Plant preoperational monitoring program. Three species, white crappie, channel catfish, and smallmouth buffalo, are collected representing both commercial and game species. Sufficient fish are collected in each reservoir to yield 250 or 300 grams oven-dry weight for analytical purposes. All samples were analyzed for gamma, gross alpha, and gross beta activity. In addition, samples of each species were analyzed for ^{89}Sr and ^{90}Sr. The composite samples contained approximately the same quantity of flesh from each fish. For each

composite a subsample of material was drawn for counting. Results are given in tables 27 through 30. During this report period sufficient quantities of smallmouth buffalo were not available for analysis for one semiannual sample period.

Plankton

As indicated in table 25, net plankton was collected for radiological analyses at four stations by vertical tows with a one-half meter, 100 micro-mesh net. For analytical accuracy, at least 50 grams (wet weight) of material is required; and collection of such amounts is usually practical only during the period April to September because of seasonal variability in plankton abundance. All samples were analyzed for gross beta activity. Quantities collected were not sufficient for gamma-emitting radionuclides, and strontium analyses. Analytical results of collected samples are given in table 31.

Sediment

Sediment samples were collected from dredge hauls made for bottom fauna quarterly from three stations and semiannually from one station. Gross beta, gamma activity, ^{89}Sr, and ^{90}Sr content were determined in samples collected from points in four cross sections. In addition, gross alpha activity was determined in samples from TRM 496.5. Each sample was a composite obtained by combining equal volumes of sediment from each of three dredge hauls at a point in the cross section. Results are given in table 32.

Shoreline sediment samples were collected semiannually at three recreation-use areas (two downstream from the plant and one upstream) in the vicinity of WBN. Samples were analyzed for gross beta, gamma-emitting radionuclides, ^{89}Sr, and ^{90}Sr. Results are given in table 33.

Figures 11 and 12 respectively present the trends in ^{137}Cs and ^{60}Co levels in sediment during the operation of the monitoring program. The upstream (control) station is located above Watts Bar Dam.

Asiatic Clams

Samples of Asiatic clams were collected with a Ponar dredge quarterly from three stations and semiannually from one station and analyzed for gamma activity. Gross alpha and gross beta analyses were also conducted on samples from TRM 496.5 and strontium activity was determined in samples of clam shells taken at that location. Results are given in tables 34 and 35.

BEST COPY AVAILABLE

Table 25

Sampling Schedule - Reservoir Monitoring

Tennessee River Mile	Biological Samples				Water Samples	
	Plankton	Benthic Fauna	Sediment	Fish*	Distance from Left Bank, %	Depths (Meters)
Indicator Stations						
496.5	X	X	X			
518.0	X	X	X		67	0
527.4	X	X	X		67	1
Control Stations						
529.9					90	1
532.1	X	X	X			

*Fish samples are taken from Watts Bar, Chickamauga, and Nickajack Reservoirs.

BEST COPY AVAILABLE

BEST COPY AVAILABLE

TABLE 26

RADIOACTIVITY IN SURFACE WATER TOTAL

PCI/L - 0.037 BQ/L

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY DECATUR TENNESSEE — REPORTING PERIOD 1983

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION [a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F) [b] RANGE [b]	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) [b] RANGE [b]	CONTROL LOCATIONS MEAN (F) [b] RANGE [b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA	2.400	3.01(47/ 88)	TRM 518.0-67-C	3.36(27/ 44)	4.68(31/ 44)	
12		2.49- 4.09		2.62- 4.09	2.48- 7.99	
GAMMA (GELI)						
12						
K-40	NOT ESTAB	8 VALUES <LLD			10.19(27/ 44)	
					7.00- 13.38	
BI-214	NOT ESTAB	5.29(57/ 88)	TRM 518.0-67-C	5.88(37/ 44)	4 VALUES <LLD	
		2.78- 8.13		2.78- 8.13		
PB-214	NOT ESTAB	3.08(17/ 88)	TRM 527.4-67-1	3.08(17/ 44)	4 VALUES <LLD	
		3.08- 3.08		3.08- 3.08		
PB-212	NOT ESTAB	3.03(67/ 88)	TRM 527.4-67-1	4.03(47/ 44)	4 VALUES <LLD	
		1.00- 5.45		1.87- 5.45		
SR 89	10.000	8 VALUES <LLD			4 VALUES <LLD	
12		ANALYSIS PERFORMED				
SR 90	2.000	8 VALUES <LLD			4 VALUES <LLD	
12		ANALYSIS PERFORMED				
TRITIUM	330.000	380.02(47/ 88)	TRM 527.4-67-1	403.04(27/ 44)	348.03(17/ 44)	
12		348.03- 412.93		393.14- 412.93	348.03- 348.03	

a. Nominal lower limit of detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).

TABLE 27

RADIOACTIVITY IN CHANNEL CATFISH (FLESH)

PCI/G - 0.037 BQ/G (DRY WEIGHT)

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY DECATUR TENNESSEE — REPORTING PERIOD 1983

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION [a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F) [b] RANGE [b]	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) [b] RANGE [b]	CONTROL LOCATIONS MEAN (F) [b] RANGE [b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS ALPHA	0.10	4 VALUES <LLD			2 VALUES <LLD	
8		ANALYSIS PERFORMED				
GROSS BETA	0.100	20.54 (4/ 4)	CHICKAMAUGA RES	22.28 (2/ 2)	17.53 (2/ 2)	
8		14.39- 23.19	TRM 471-530	21.97- 22.60	11.91- 23.15	
GAMMA (GELI)						
8						
CS-137	0.020	0.04 (2/ 4)	NICKAJACK RES	0.05 (1/ 2)	0.08 (1/ 2)	
		0.04- 0.05	TRM 425-471	0.05- 0.05	0.08- 0.08	
K-40	NOT ESTAB	9.37 (4/ 4)	CHICKAMAUGA RES	10.43 (2/ 2)	8.31 (2/ 2)	
		6.69- 11.48	TRM 471-530	9.38- 11.48	5.53- 11.09	
PB-212	NOT ESTAB	0.00 (1/ 4)	CHICKAMAUGA RES	0.00 (1/ 2)	0.00 (1/ 2)	
		0.00- 0.00	TRM 471-530	0.00- 0.00	0.00- 0.00	
SR 89	0.500	4 VALUES <LLD			2 VALUES <LLD	
8		ANALYSIS PERFORMED				
SR 90	0.100	4 VALUES <LLD			2 VALUES <LLD	
8		ANALYSIS PERFORMED				

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).

BEST COPY AVAILABLE

49

TABLE 28

RADIOACTIVITY IN WHITE CRAPPIE (FLESH)

PCI/G - 0.037 BQ/G (DRY WEIGHT)

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391

LOCATION OF FACILITY DECA — TENNESSEE — REPORTING PERIOD 1983

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION[a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE	LOCATION WITH HIGHEST ANNUAL MEAN NAME, DISTANCE AND DIRECTION	MEAN (F)[b] RANGE	CONTROL LOCATIONS MEAN (F)[b] RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS ALPHA	0.100	0.34(1/ 4)	CHICKAMAUGA RES	0.34(1/ 2)	2 VALUES <LLD	
6		0.34- 0.34	TRM 471-530	0.34- 0.34		
GROSS BETA	0.100	34.69(4/ 4)	NICKAJACK RES	35.10(2/ 2)	18.38(2/ 2)	
6		31.76- 38.45	TRM 425-471	31.76- 38.45	16.43- 20.33	
GAMMA (GELI)						
6						
CS-137	0.020	0.11(4/ 4)	CHICKAMAUGA RES	0.11(2/ 2)	0.07(2/ 2)	
		0.06- 0.13	TRM 471-530	0.11- 0.12	0.06- 0.08	
K-40	NOT ESTAB	16.72(4/ 4)	CHICKAMAUGA RES	17.32(2/ 2)	7.74(2/ 2)	
		15.72- 17.51	TRM 471-530	17.13- 17.51	7.19- 8.28	
PB-214	NOT ESTAB	0.01(1/ 4)	CHICKAMAUGA RES	0.01(1/ 2)	2 VALUES <LLD	
		0.01- 0.01	TRM 471-530	0.01- 0.01		
PB-212	NOT ESTAB	0.06(2/ 4)	CHICKAMAUGA RES	0.00(1/ 2)	2 VALUES <LLD	
		0.00- 0.00	TRM 471-530	0.00- 0.00		
SR 89	0.500	0.68(1/ 4)	CHICKAMAUGA RES	0.68(1/ 2)	2 VALUES <LLD	
6		0.68- 0.68	TRM 471-530	0.68- 0.68		
SR 90	0.100	4 VALUES <LLD			2 VALUES <LLD	
6		ANALYSIS PERFORMED				

[a] Nominal Lower Limit of Detection (LLD) as described in Table 3.

[b] Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).

TABLE 29

RADIOACTIVITY IN SMALLMOUTH BUFFALO (FLESH)

PCI/G - 0.037 BQ/G (DRY WEIGHT)

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY DECATUR TENNESSEE — REPORTING PERIOD 1983

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD)[a]	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F)[b]	RANGE[b]	CONTROL LOCATIONS MEAN (F)[b] RANGE[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS ALPHA	0.100	4 VALUES <LLD				0.14(1/ 2)	
6						0.14- 0.14	
GROSS BETA	0.100	20.63(4/ 4)	NICKAJACK RES	21.19(2/ 2)		20.37(2/ 2)	
6		13.61- 26.52	TRM 425-471	18.94-	23.44	19.07- 21.67	
GAMMA (GELI)							
6							
CS-137	0.020	0.07(2/ 4)	CHICKAMAUGA RES	0.07(1/ 2)		0.04(1/ 2)	
		0.07- 0.07	TRM 471-530	0.07-	0.07	0.04- 0.04	
K-40	NOT ESTAB	9.97(4/ 4)	NICKAJACK RES	10.82(2/ 2)		8.37(2/ 2)	
		6.61- 11.64	TRM 425-471	10.27-	11.37	7.40- 9.33	
PB-214	NOT ESTAB	0.00(1/ 4)	CHICKAMAUGA RES	0.00(1/ 2)		2 VALUES <LLD	
		0.00- 0.00	TRM 471-530	0.00-	0.00		
PB-212	NOT ESTAB	0.00(2/ 4)	NICKAJACK RES	0.00(1/ 2)		2 VALUES <LLD	
		0.00- 0.00	TRM 425-471	0.00-	0.00		
SR 89	0.500	4 VALUES <LLD				2 VALUES <LLD	
6		ANALYSIS PERFORMED					
SR 90	0.100	4 VALUES <LLD				2 VALUES <LLD	
6		ANALYSIS PERFORMED					

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).

BEST COPY AVAILABLE

TABLE 30

RADIOACTIVITY IN SMALLMOUTH BUFFALO (WHOLE)

PCI/G - 0.037 BQ/G (DRY WEIGHT)

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY DECATUR TENNESSEE — REPORTING PERIOD 1983

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION[a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE[b]	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F)[b]	RANGE[b]	CONTROL LOCATIONS MEAN (F)[b] RANGE[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS ALPHA	0.100	0.20(1/ 3)	CHICKAMAUGA RES	0.20(	1/ 2)	0.18(1/ 2)	
5		0.20- 0.20	TRM 471-530	0.20-	0.20	0.18- 0.18	
GROSS BETA	0.100	14.68(3/ 3)	CHICKAMAUGA RES	15.29(	2/ 2)	12.54(2/ 2)	
5		12.60- 17.97	TRM 471-530	12.60-	17.97	11.71- 13.36	
GAMMA (GELI)							
5							
CS-137	0.020	0.03(1/ 3)	CHICKAMAUGA RES	0.03(	1/ 2)	2 VALUES <LLD	
		0.03- 0.03	TRM 471-530	0.03-	0.03		
K-40	NOT ESTAB	5.65(3/ 3)	CHICKAMAUGA RES	6.06(	2/ 2)	5.38(2/ 2)	
		4.49- 7.62	TRM 471-530	4.49-	7.62	4.98- 5.77	
PB-214	NOT ESTAB	3 VALUES <LLD				0.02(1/ 2)	
						0.02- 0.02	
PB-212	NOT ESTAB	0.01(3/ 3)	CHICKAMAUGA RES	0.02(	2/ 2)	0.00(1/ 2)	
		0.00- 0.02	TRM 471-530	0.01-	0.02	0.00- 0.00	
SR 89	0.500	1.17(1/ 3)	CHICKAMAUGA RES	1.17(	1/ 2)	2 VALUES <LLD	
5		1.17- 1.17	TRM 471-530	1.17-	1.17		
SR 90	0.100	0.14(2/ 3)	CHICKAMAUGA RES	0.16(	1/ 2)	0.11(1/ 2)	
5		0.12- 0.16	TRM 471-530	0.16-	0.16	0.11- 0.11	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).

TABLE 31

RADIOACTIVITY IN PLANKTON

PCI/G - 0.037 BQ/G (DRY WEIGHT)

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY DECATUR TENNESSEE — REPORTING PERIOD 1983

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION [a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F) [b] RANGE	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) [b] RANGE	CONTROL LOCATIONS MEAN (F) [b] RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA	0.100	30.96(12/ 12)	TRM 518.0	39.17(4/ 4)	12.81(4/ 4)	
16		2.26- 52.01		32.89- 43.68	8.25- 14.51	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).

BEST COPY AVAILABLE

TABLE 32

RADIOACTIVITY IN SEDIMENT

PCI/G - 0.037 BQ/G (DRY WEIGHT)

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY DECATUR TENNESSEE — REPORTING PERIOD 1983

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION [a]	ALL INDICATOR LOCATIONS MEAN (F) [b] RANGE [b]	LOCATION WITH HIGHEST ANNUAL MEAN NAME / DISTANCE AND DIRECTION	MEAN (F) [b] RANGE [b]	CONTROL LOCATIONS MEAN (F) [b] RANGE [b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS ALPHA	0.350	9.74(2/ 2)	TRM 496.50	9.74(2/ 2)		
2		8.06- 11.42		8.06- 11.42		
GROSS BETA	0.700	45.50(10/ 10)	TRM 518.0	48.55(4/ 4)	49.93(4/ 4)	
14		24.15- 61.75		29.34- 55.98	37.31- 65.42	
GAMMA (GELI)						
14						
CO-60	0.010	0.06(6/ 10)	TRM 496.50	0.10(2/ 2)	0.30(4/ 4)	
		0.01- 0.14		0.06- 0.14	0.17- 0.52	
CS-137	0.020	0.31(10/ 10)	TRM 496.50	0.91(2/ 2)	3.37(4/ 4)	
		0.05- 1.36		0.47- 1.36	2.57- 4.15	
K-40	NOT ESTAB	15.24(10/ 10)	TRM 518.0	16.76(4/ 4)	15.01(4/ 4)	
		12.34- 19.87		15.09- 17.30	13.65- 16.57	
BI-214	0.020	0.82(10/ 10)	TRM 527.4	0.85(4/ 4)	1.00(4/ 4)	
		0.66- 1.06		0.66- 1.06	0.80- 1.17	
BI-212	0.100	1.24(10/ 10)	TRM 527.4	1.30(4/ 4)	1.44(3/ 4)	
		1.02- 1.51		1.13- 1.51	1.01- 1.93	
PB-214	NOT ESTAB	0.92(10/ 10)	TRM 527.4	0.96(4/ 4)	1.08(4/ 4)	
		0.79- 1.15		0.79- 1.15	0.90- 1.28	
PB-212	NOT ESTAB	1.18(10/ 10)	TRM 527.4	1.15(4/ 4)	1.40(4/ 4)	
		0.93- 1.34		0.93- 1.34	1.18- 1.65	
RA-226	NOT ESTAB	0.82(10/ 10)	TRM 527.4	0.85(4/ 4)	1.00(4/ 4)	
		0.66- 1.06		0.66- 1.06	0.80- 1.17	
RA-223	NOT ESTAB	0.34(2/ 10)	TRM 496.50	0.39(1/ 2)	4 VALUES <LLD	
		0.29- 0.39		0.39- 0.39		
RA-224	NOT ESTAB	1.15(10/ 10)	TRM 527.4	1.17(4/ 4)	1.42(3/ 4)	
		1.00- 1.34		1.05- 1.34	1.16- 1.77	
BE-7	NOT ESTAB	0.45(2/ 10)	TRM 518.0	0.45(2/ 4)	4 VALUES <LLD	
		0.34- 0.56		0.34- 0.56		
TL-208	0.020	0.38(10/ 10)	TRM 527.4	0.39(4/ 4)	0.44(4/ 4)	
		0.32- 0.46		0.32- 0.46	0.38- 0.53	
AC-228	0.060	1.16(10/ 10)	TRM 527.4	1.20(4/ 4)	1.44(4/ 4)	
		0.96- 1.40		0.96- 1.40	1.17- 1.82	
PA-234M	NOT ESTAB	3.60(1/ 10)	TRM 527.4	3.60(1/ 4)	2.47(1/ 4)	
		3.60- 3.60		3.60- 3.60	2.47- 2.47	
SR 89	1.500	4.33(6/ 10)	TRM 518.0	6.20(2/ 4)	3.56(3/ 4)	
14		1.51- 14.03		2.37- 14.03	1.74- 6.06	
SR 90	0.300	10 VALUES <LLD			4 VALUES <LLD	
14		ANALYSIS PERFORMED				

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).

TABLE 33

RADIOACTIVITY IN SHORE LINE SEDIMENT

PCI/G - 0.037 BQ/G (DRY WEIGHT)

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY DECATUR TENNESSEE — REPORTING PERIOD 1983

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION [a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F) [b] RANGE [b]	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) [b] RANGE [b]	CONTROL LOCATIONS MEAN (F) [b] RANGE [b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA 6	0.700	46.72(4/ 4) 32.59- 65.28	COTTON PORT MARI TRM 513	60.05(2/ 2) 54.83- 65.28	17.98(2/ 2) 5.85- 30.10	
GAMMA (GELI) 6						
CO-60	0.010	0.06(1/ 4) 0.06- 0.06	COTTON PORT MARI TRM 513	0.06(1/ 2) 0.06- 0.06	2 VALUES <LLD	
CS-137	0.020	0.56(2/ 4) 0.30- 0.82	COTTON PORT MARI TRM 513	0.82(1/ 2) 0.82- 0.82	2 VALUES <LLD	
K-40	NOT ESTAB	11.85(4/ 4) 5.09- 18.35	COTTON PORT MARI TRM 513	17.74(2/ 2) 17.12- 18.35	3.86(2/ 2) 0.55- 7.18	
BI-214	0.020	0.80(4/ 4) 0.60- 0.99	COTTON PORT MARI TRM 513	0.89(2/ 2) 0.79- 0.99	0.47(2/ 2) 0.19- 0.75	
BI-212	0.100	1.30(3/ 4) 1.09- 1.50	COTTON PORT MARI TRM 513	1.40(2/ 2) 1.30- 1.50	0.78(2/ 2) 0.29- 1.28	
PB-214	NOT ESTAB	0.93(4/ 4) 0.86- 1.07	COTTON PORT MARI TRM 513	0.97(2/ 2) 0.86- 1.07	0.55(2/ 2) 0.24- 0.87	
PB-212	0.020	1.08(4/ 4) 0.93- 1.27	COTTON PORT MARI TRM 513	1.22(2/ 2) 1.16- 1.27	0.73(2/ 2) 0.23- 1.23	
RA-226	NOT ESTAB	0.87(3/ 4) 0.79- 0.99	COTTON PORT MARI TRM 513	0.89(2/ 2) 0.79- 0.99	0.47(2/ 2) 0.19- 0.75	
RA-224	NOT ESTAB	1.24(3/ 4) 1.09- 1.37	COTTON PORT MARI TRM 513	1.32(2/ 2) 1.28- 1.37	1.31(1/ 2) 1.31- 1.31	
TL-208	0.020	0.38(4/ 4) 0.32- 0.45	COTTON PORT MARI TRM 513	0.44(2/ 2) 0.43- 0.45	0.24(2/ 2) 0.08- 0.40	
AC-228	0.060	1.06(4/ 4) 0.70- 1.27	COTTON PORT MARI TRM 513	1.27(2/ 2) 1.27- 1.27	0.76(2/ 2) 0.25- 1.27	
PA-234M	NOT ESTAB	2.41(1/ 4) 2.41- 2.41	GRASSHOPPER CREE TRM 496	2.41(1/ 2) 2.41- 2.41	2 VALUES <LLD	
SR 89	1.500	1.79(2/ 4) 1.76- 1.83	GRASSHOPPER CREE TRM 494	1.83(1/ 2) 1.83- 1.83	2.79(1/ 2) 2.79- 2.79	
SR 90 6	0.300	4 VALUES <LLD			2 VALUES <LLD	
	0	ANALYSIS PERFORMED				
	6	ANALYSIS PERFORMED				

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).

BLANK PAGE

BLANK PAGE

BLANK PAGE

best copy
available

TABLE 34

RADIOACTIVITY IN CLAM FLESH

PCT/G - 0.037 BQ/G (DRY WEIGHT)

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY DECATUR TENNESSEE — REPORTING PERIOD 1983

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION[a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE[b]	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F)[b] RANGE[b]	CONTROL LOCATIONS MEAN (F)[b] RANGE[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS ALPHA	0.100	0.35(2/ 2)	TRM 496.50	0.35(2/ 2)		
2		0.22- 0.48		0.22- 0.48		
GROSS BETA	0.100	4.77(2/ 2)	TRM 496.50	4.77(2/ 2)		
2		3.69- 5.84		3.69- 5.84		
GAMMA (GELI)						
14						
K-40	NOT ESTAB	1.66(6/ 10)	TRM 527.4	2.03(2/ 4)	1.97(3/ 4)	
		0.52- 2.89		1.17- 2.89	1.00- 3.09	
BI-214	NOT ESTAB	0.52(10/ 10)	TRM 527.4	0.61(4/ 4)	0.25(4/ 4)	
		0.10- 1.59		0.10- 1.59	0.09- 0.43	
PB-214	NOT ESTAB	0.66(7/ 10)	TRM 527.4	1.03(2/ 4)	0.20(4/ 4)	
		0.17- 1.47		0.59- 1.47	0.00- 0.39	
PB-212	NOT ESTAB	0.09(4/ 10)	TRM 527.4	0.13(2/ 4)	0.08(3/ 4)	
		0.00- 0.16		0.11- 0.16	0.04- 0.10	
RA-226	NOT ESTAB	10 VALUES <LLD			0.09(1/ 4)	
					0.09- 0.09	
TL-208	NOT ESTAB	0.01(2/ 10)	TRM 496.50	0.02(1/ 2)	0.03(1/ 4)	
		0.01- 0.02		0.02- 0.02	0.03- 0.03	
AC-228	NOT ESTAB	0.10(2/ 10)	TRM 496.50	0.10(2/ 2)	4 VALUES <LLD	
		0.06- 0.14		0.06- 0.14		

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).

TABLE 35

RADIOACTIVITY IN CLAM SHELL

PCI/G - 0.037 BQ/G (DRY WEIGHT)

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391

LOCATION OF FACILITY DECATUR TENNESSEE — REPORTING PERIOD 1983

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION[a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE[b]	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F)[b] RANGE[b]	CONTROL LOCATIONS MEAN (F)[b] RANGE[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS ALPHA	0.700	1.80(2/ 2)	TRM 496.50	1.80(2/ 2)		
2		1.61- 1.99		1.61- 1.99		
GROSS BETA	0.700	6.91(2/ 2)	TRM 496.50	6.91(2/ 2)		
2		5.41- 8.40		5.41- 8.40		
GAMMA (GELI)						
14						
CO-60	0.010	0.02(5/ 10)	TRM 496.50	0.03(1/ 2)	4 VALUES <LLD	
		0.01- 0.03		0.03- 0.03		
K-40	NOT ESTAB	0.14(9/ 10)	TRM 496.50	0.15(2/ 2)	0.06(2/ 4)	
		0.07- 0.18		0.13- 0.18	0.03- 0.09	
BI-214	0.050	0.11(10/ 10)	TRM 496.50	0.12(2/ 2)	0.06(1/ 4)	
		0.07- 0.16		0.08- 0.16	0.06- 0.06	
BI-212	0.100	0.16(5/ 10)	TRM 496.50	0.23(1/ 2)	4 VALUES <LLD	
		0.12- 0.23		0.23- 0.23		
PB-214	0.050	0.12(9/ 10)	TRM 496.50	0.13(2/ 2)	0.06(2/ 4)	
		0.07- 0.16		0.09- 0.16	0.05- 0.07	
PB-212	NOT ESTAB	0.09(10/ 10)	TRM 496.50	0.12(2/ 2)	0.02(4/ 4)	
		0.04- 0.15		0.08- 0.15	0.02- 0.03	
RA-226	0.050	0.11(8/ 10)	TRM 518.0	0.12(3/ 4)	4 VALUES <LLD	
		0.07- 0.16		0.10- 0.14		
TL-208	0.020	0.03(9/ 10)	TRM 496.50	0.04(2/ 2)	4 VALUES <LLD	
		0.02- 0.05		0.03- 0.05		
AC-228	0.060	0.19(9/ 10)	TRM 518.0	0.21(4/ 4)	0.12(2/ 4)	
		0.11- 0.26		0.19- 0.24	0.08- 0.15	
SR 89	5.000	2 VALUES <LLD			0 VALUES <LLD	
2		ANALYSIS PERFORMED				
SR 90	1.000	1.54(2/ 2)	TRM 496.50	1.54(2/ 2)		
2		1.33- 1.75		1.33- 1.75		

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.

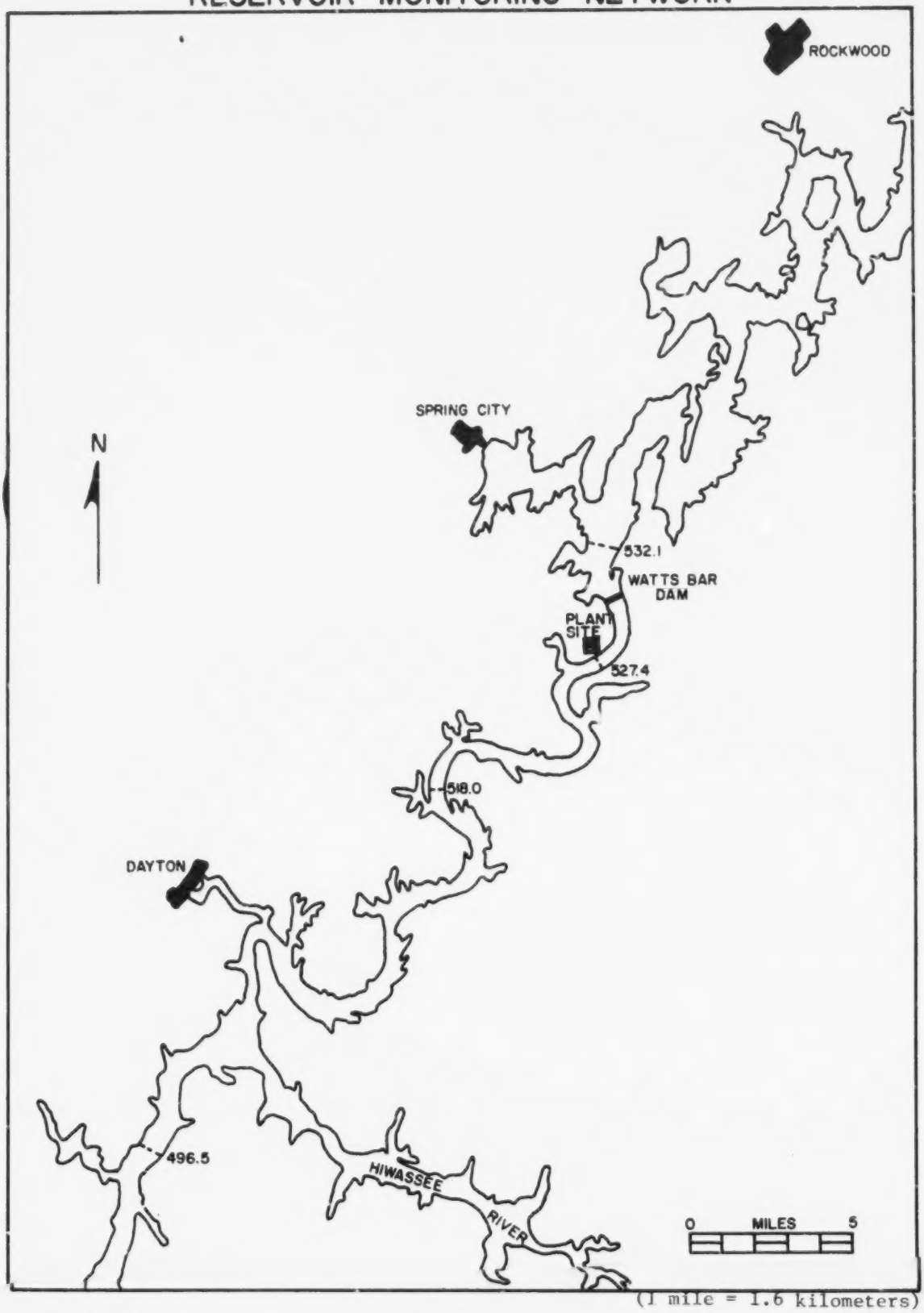
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).

BEST COPY AVAILABLE

57

Figure 10

RESERVOIR MONITORING NETWORK



(1 mile = 1.6 kilometers)

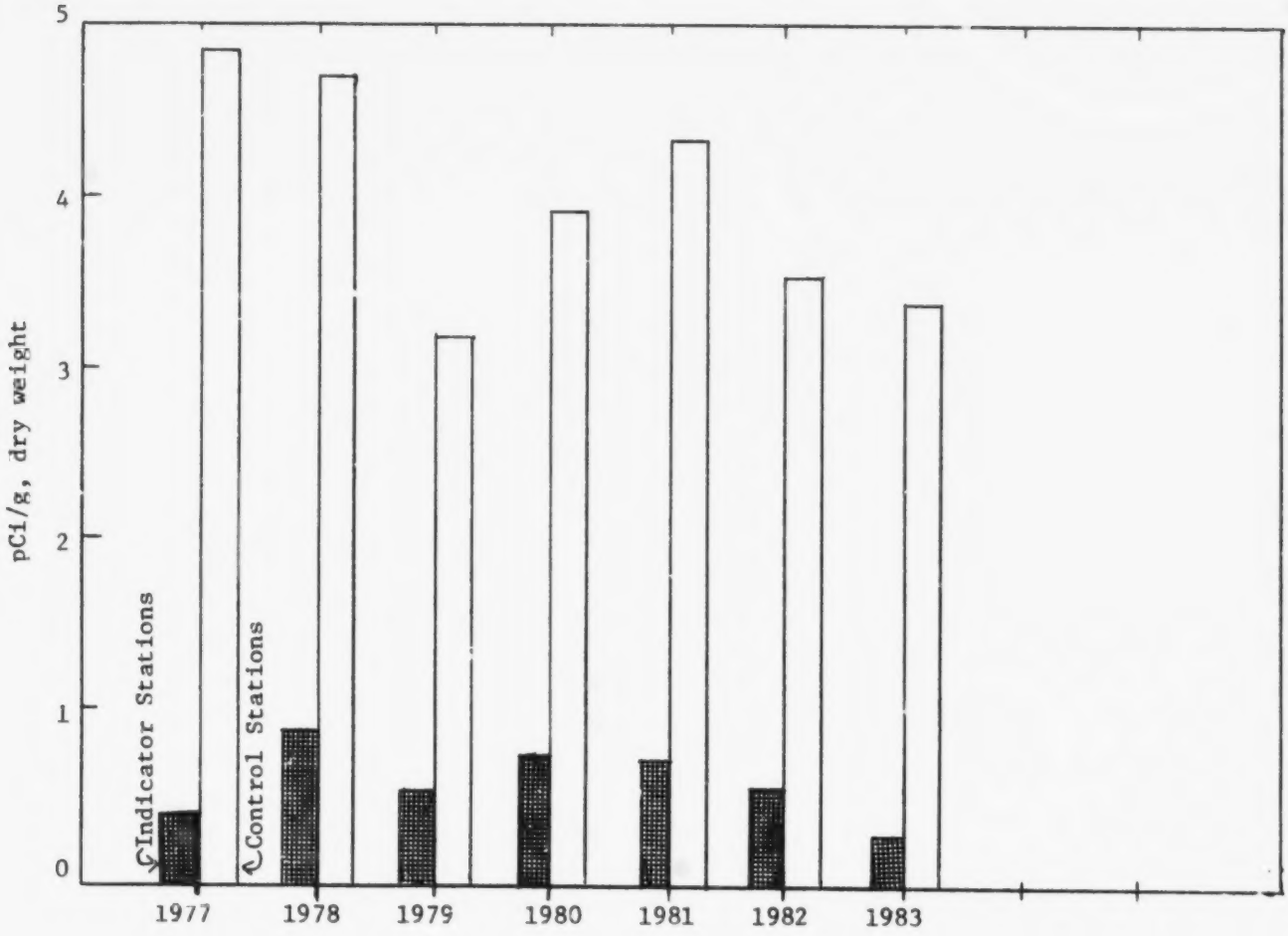
BEST COPY AVAILABLE

Figure 11

Annual Average

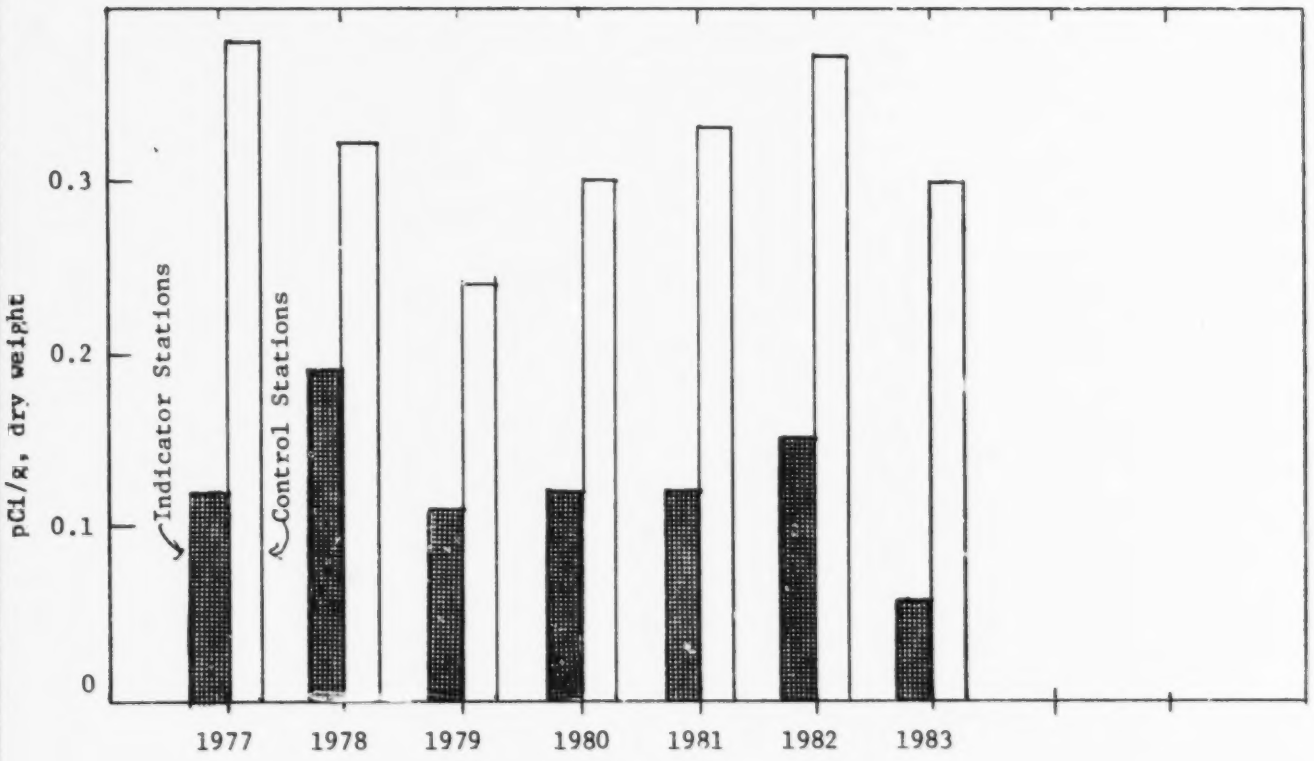
Cesium-137 in Sediment

Watts Bar Nuclear Plant



BEST COPY AVAILABLE

Figure 12
Annual Average
Cobalt-60 in Sediment
Watts Bar Nuclear Plant



BEST COPY AVAILABLE

Quality Control

A quality control program has been established with the Tennessee Department of Public Health Radiological Laboratory and the Eastern Environmental Radiation Facility, Environmental Protection Agency, Montgomery, Alabama. Samples of air, water, milk, fish, and soil collected around nuclear plants are forwarded to these laboratories for analysis, and results are exchanged for comparison.

Conclusions

Since WBN has not achieved criticality, there has been no contribution of radioactivity from the plant to the environment. The levels of radioactivity being reported in this document are due to natural background radiation, fallout from nuclear weapons testing, or other nuclear operations in the area.

BEST COPY AVAILABLE